UNDEFEATED 4TH GENERATION SUPER-FIGHTER!

F-15 EAGLE

AIR-TO-AIR FIGHTER

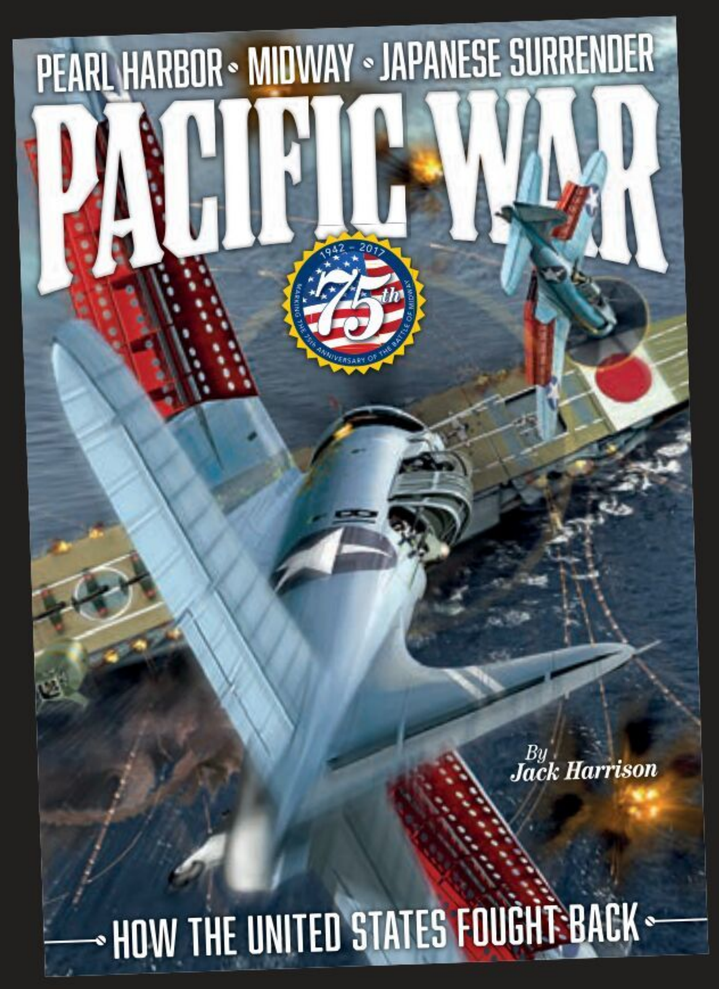
ADVANCED STRIKER

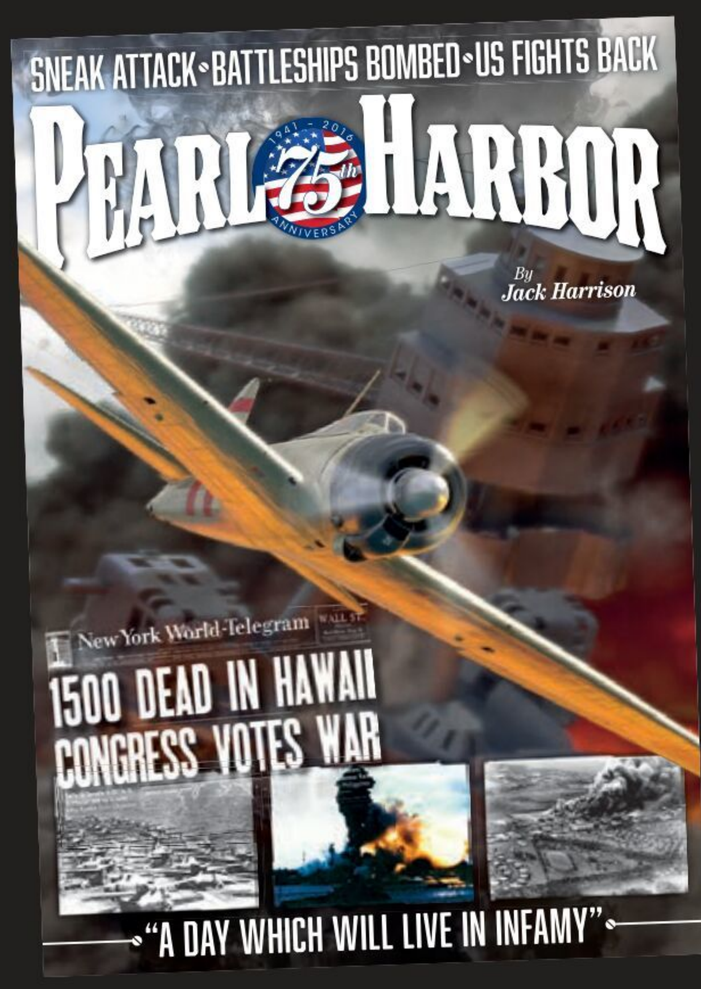
SYSTEMS
VARIANTS
COMBAT OPS
DEVELOPMENT

MORTONS MEDIA GROUP LTD
9 781911 276685
£7.99
In association with Aviation Classics

ON SALE NOW...

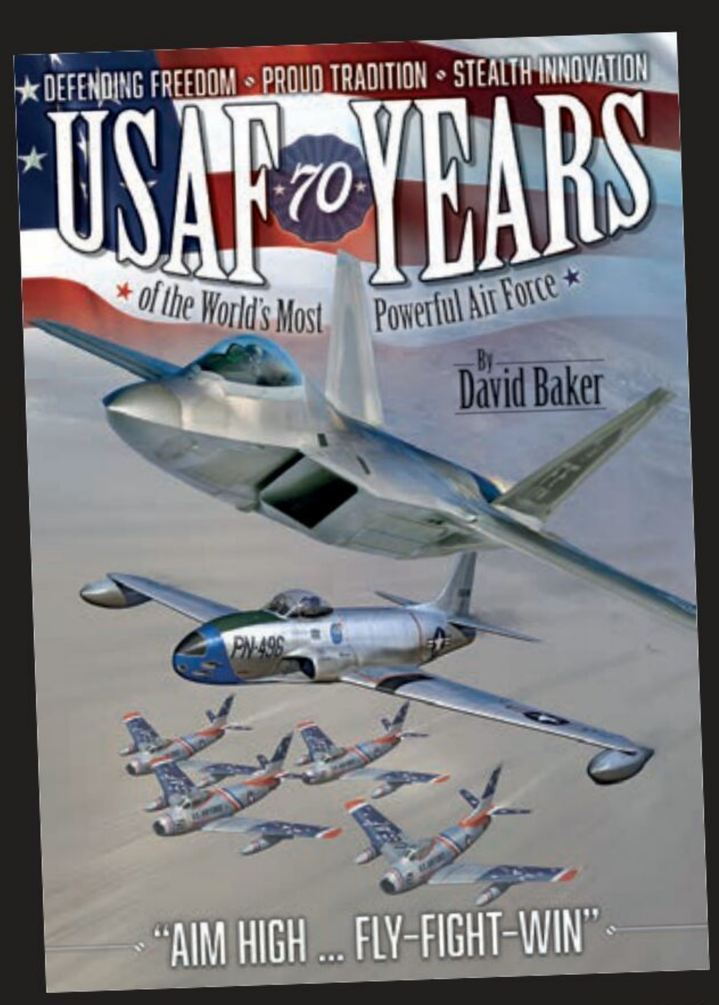
AVIATION, MILITARY AND HISTORY SPECIAL EDITIONS...




SNEAK ATTACK • BATTLESHIPS BOMBED • US FIGHTS BACK
PEARL HARBOR
1941 - 2016
75th ANNIVERSARY
By Jack Harrison
New York World-Telegram
1500 DEAD IN HAWAII
CONGRESS VOTES WAR
"A DAY WHICH WILL LIVE IN INFAMY"

More than 200 unique and expertly drawn colour profiles
LUFTWAFFE FIGHTERS
GERMAN WW2 DESIGNS BY CLAES SUNDIN
DETAILED AIRCRAFT SPECIFICATIONS AND MILITARY HISTORIES
COLOURS AND MARKINGS FROM 1939 TO 1945
INCLUDES THE TOP LUFTWAFFE ACES' AIRCRAFT

HITLER'S 'WONDER WEAPON' AIRCRAFT PROJECTS
LUFTWAFFE
Secret Designs of the Third Reich
More than 300 rare drawings and photos
FLYING TRIANGLE JET BOMBER
NEW ARCHIVE DISCOVERIES
ME 163 TESTED WITH CANARDS
ROCKET-POWERED GOTHA TANK BUSTER
Dan Sharp
CLASSIFIED GERMAN WW2 AVIATION DESIGNS REVEALED IN DETAIL


DEFENDING FREEDOM • PROUD TRADITION • STEALTH INNOVATION
USAF 70 YEARS
of the World's Most Powerful Air Force
By David Baker
"AIM HIGH ... FLY-FIGHT-WIN"

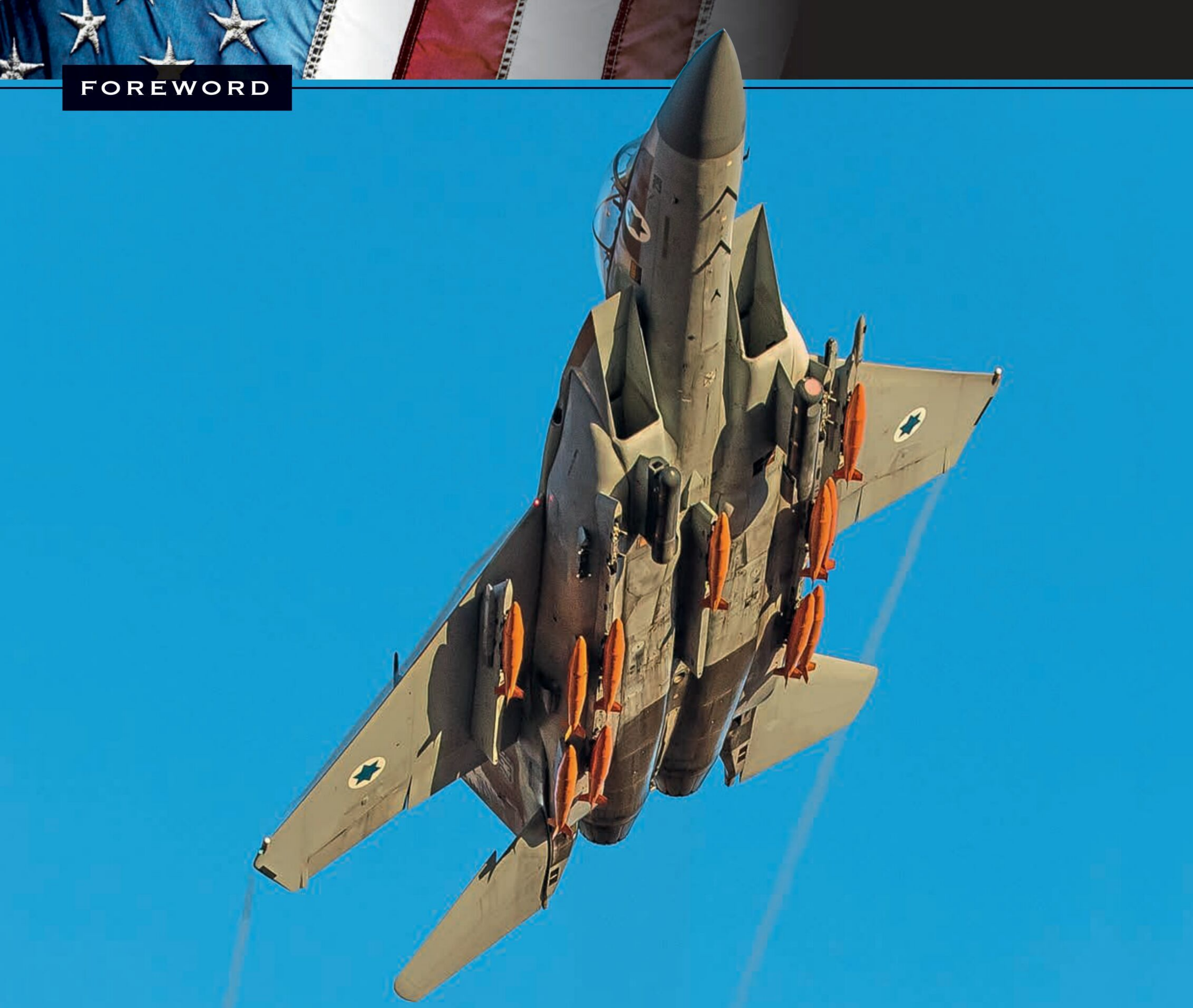
ORDER TODAY FROM classic magazines

classicmagazines.co.uk/thebookshelf

01507 529529

Available at WHSmith

FROM £6.99



Foreword

Even more than 45 years since its first flight, the McDonnell Douglas/Boeing F-15 Eagle is still at the very tip of the spear for a number of air forces around the globe.

Born at the very height of the Cold War, the F-15 was developed during the mid-1960s as a successor to the multirole, two-seat F-4 Phantom II.

Initially intended as a pure air-to-air interceptor and air-superiority fighter, the F-15's design learned the lessons of the Vietnam air war. It housed a single pilot under a blown 'bubble' canopy for an unobstructed view in front, above and behind. It also packed a high-tech missile armament into a highly-agile airframe that boasted a capable look-down/shoot-down radar, two lightweight yet powerful F-100 turbofan engines and that all-important gun for close-in dogfighting.

Thanks to a high price tag only a select few nations were allowed to or could afford to purchase the mighty Eagle but it was soon in action with the Israeli air force where it made its first kill way back in 1979. Since then the Eagle has never been bested in air combat and has a 'more than' 100-0 kill ratio.

The latent air-to-ground capability was then harnessed in the new F-15E 'Strike Eagle' which ushered in a new era of accuracy and survivability for aircrew. The USAF's fighter and strike versions of the F-15 made their combat debut in the 1991 Gulf War. Since then the F-15E has matured into one of the world's most capable strike aircraft serving with a number of air forces across the globe, including Israel, the Republic of Korea, Saudi Arabia and Singapore.

Today despite the introduction of the F-22A Raptor, the F-15C Eagle is still the most numerous air-superiority fighter in the USAF's arsenal and – while still in production for export customers – could still yet be built for the US once more if plans for an F-15X come to fruition. It seems there's life in the old bird yet…

Bertie Simmonds

Contents

006 **CHAPTER 1**
Air superiority at all costs

020 **CHAPTER 2**
Fledgling fighter

038 **CHAPTER 3**
Into service

054 **CHAPTER 4**
Export Eagles

064 **CHAPTER 5**
Building the Beagle

076 **CHAPTER 6**
The Eagle air-to-air

094 **CHAPTER 7**
Air-to-ground in the Eagle

102 **CHAPTER 8**
The eyrie

114 **CHAPTER 9**
The Eagle today

130 Survivors on display

AUTHOR: Bertie Simmonds
DESIGN: Lucy Carnell atg-media.com, Justin Blackamore, Holly Furness
PUBLISHING DIRECTOR: Dan Savage
PUBLISHER: Steve O'Hara
PICTURE DESK: Jonathan Schofield and Paul Fincham
PRODUCTION EDITOR: Dan Sharp
MARKETING MANAGER: Charlotte Park
COMMERCIAL DIRECTOR: Nigel Hole

PUBLISHED BY: Mortons Media Group Ltd, Media Centre, Morton Way, Horncastle, Lincolnshire LN9 6JR.
Tel: 01507 529529

PHOTOGRAPHY
Amit Agronov, Alan Wesley, Patrick Vercauteren, Richard Vandervord, Christopher McGreevy, Simon Jones, Jane Jones, Louise 'Ding Dong' Bell, Erik Bruijns, Dryden Research Centre, Wikipedia, USAF

PROFILES
JP Vieira

CUTAWAYS
Mike Badrocke

AKNOWLEDGEMENTS & BIBLIOGRAPHY
- Osprey Combat Aircraft 67: Israeli F-15 Eagle Units in Combat – Shlomo Aloni
- Osprey F-15C Eagle vs MiG-23/25 – Doug Dildy and Tom Cooper
- Dogfights: originally aired on The History Channel
- The Aviation Geek Club
- Aircrew Interview: www.aircrewinterview.tv/www.facebook.com/aircrewinterview
- TOP GUNS – Joe Foss and Matthew Brennan
- World Air Power Journal, Volume 9, Aerospace Publishing Ltd
- Modern Combat Aircraft: F-15 Eagle – Jeff Ethell
- Thanks also to Ron Downey and Missouri Historical Society via Aviation Archives.
- TAKE OFF, Aerospace Publishing
- Grumman Tomcat: Bye, bye baby – various authors

MORTONS MEDIA GROUP LTD

DEDICATION:
To my 'nephew' Alex Wesley: 1999-2018
and in memory of Don Kilgus: 1937-1988

PRINTED BY: William Gibbons and Sons, Wolverhampton

ISBN: 978-1-911276-68-5

© 2018 Mortons Media Group Ltd. All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage retrieval system without prior permission in writing from the publisher.

AIR SUPERIORITY AT ALL COSTS

Modern air-superiority personified: Tyndall F-15Cs with their successor the F-22A Raptor.

F-15 FACTS

"More than 500 F-15 Eagles are in service with the USAF alone."

CHAPTER 1 – AIR SUPERIORITY

The USA had been engaged in all of the major aerial conflicts before the coming of the F-15 Eagle and yet this mighty nation had to re-learn all the lessons of air-superiority.

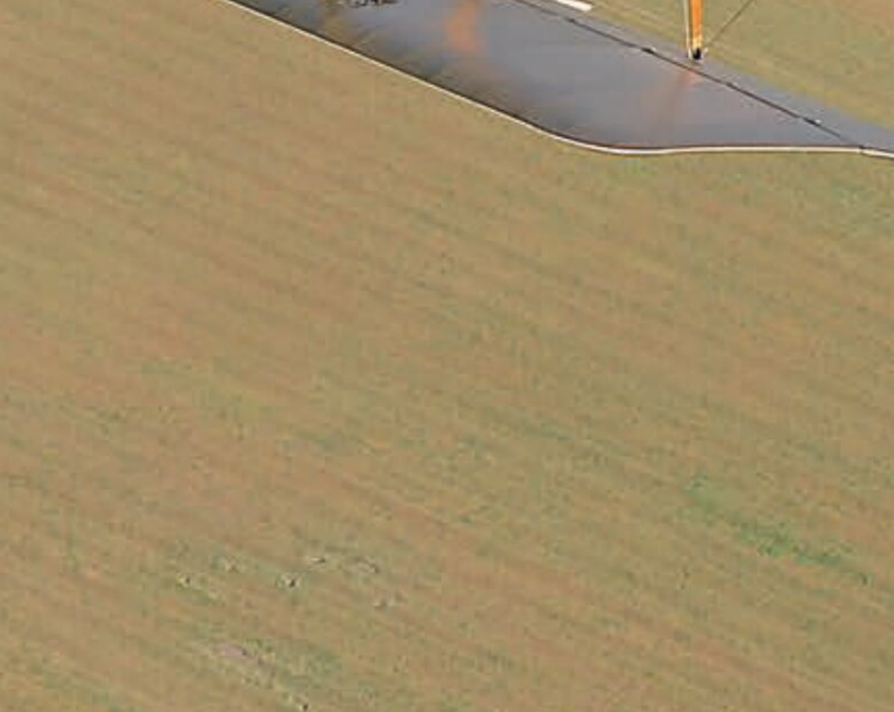
Air superiority is where one air force seizes control of the disputed skies above a battlefield to establish dominance – giving that side's ground forces an undeniable tactical advantage. The idea has its roots in the very beginnings of air warfare.

Despite being ahead of the game when it came to aviation following the Wright Brothers' first powered flight in 1903, American military interest in aviation fell behind that of the European powers in the years after. This meant that – even by the time the USA entered hostilities and despite many millions of dollars being earmarked for the building of military aircraft – the first American fighter pilots would be using mainly French aircraft and Allied tactics of the time.

The upshot was that – initially at least – fledgling aviators over the trenches of the Western Front were there to provide tactical support to the troops on the ground. At first this meant reconnaissance (including artillery observation) and later attacking targets of their own with small bombs before eventually taking part in fighter-versus-fighter combat. This was where 'air superiority' was born: the concept of projecting power over a combat zone, securing the airspace above a battlefield and therefore controlling it. Dawn patrols, fighter squadrons, circuses and dedicated

***RIGHT:** Before the Fokker Eindecker's interrupter gear, French pilot Roland Garros used deflector wedges to allow him to aim through the airscrew of his scout.*

***ABOVE:** Early in the air war over the Western Front, machines such as the B.E.2 were used for observation.*



F-15 FACTS

The F-15 Eagle's production line is open until at least 2022.

ABOVE: ***The Sopwith Camel was both fast and agile.***

fighter aircraft designs were a result of the importance of securing air superiority so that their own aircraft could act with impunity and therefore support ground troops – who could then win the battle on the field.

THE NEED FOR AN ESCORT FIGHTER

During the initial stages of the Second World War, Great Britain and the Allied European powers they were on the receiving end of a well-drilled and army-focused assault during the Blitzkrieg of 1940, where the Wehrmacht moved forward under a protective umbrella provided by the Nazi air-arm. Having established air dominance in the first 10 months of the war, together they destroyed almost all in their path – until the Luftwaffe took on Great Britain's Royal Air Force.

Bolstered by pilots and aircrew from the home islands, the Commonwealth, countries that had already fallen to the Nazis and some from the free world – including the USA – Britain's RAF took air superiority from the Nazi regime and learned their own lessons from the more experienced German air arm.

How? Well, in the form of defensive aircraft such as the Hawker Hurricane and Supermarine Spitfire the Nazi air arm was facing machines at least the equal of its own Messerschmitt Bf 109 and Bf 110. Also, fighting over their own country the RAF were at an advantage when it came to range and of course pilots who bailed out did so over friendly territory.

Another big advantage was the use of the pioneering RDF or Range and Direction Finding, known as radar. A series of RDF stations known as Chain Home gave precious information to the defending force on where Nazi formations were building up, what size they were and – when looking at the direction of the incoming 'plots', their likely intended targets. This would give the defending pilots greater 'situational awareness' of what was going on in the skies around them.

Following the fall of France in the spring of 1940, tactically, changes in formation and approach would also be applied by the RAF. They had to learn the hard way the lessons learned by the Luftwaffe themselves in the Spanish Civil War. This would include basic tactical formations – which for the RAF meant a move away from the tight Vic formation of three (later including a 'trailer' aircraft) towards the Luftwaffe 'Schwarm' (or two pairs, one pair being called a 'Rotte') which in turn became the RAF 'finger four' formation.

This had its beginnings with the Finnish Air Force, who used the formation during their air wars of the 1930s. In Spain, the fledgling Luftwaffe also adopted this formation. This was where four aircraft would almost represent the tips of the fingers of a right hand (without the thumb, obviously). The furthermost 'fingertip' was the flight leader and the aircraft on his immediate left was the flight wingman. The second pairing were effectively 'element leader and wingman' of the four. This flight of four could then work together to scan the skies around the four-ship element. Ironically – and despite the Luftwaffe's initial superiority numbers-wise – the Finns adopted this flexible tactical formation

The United States and its various air forces, be they the USAAF, the Marines or Navy also had to learn this the hard way during the Second World War – often adapting tactics used by their own allies during the early years of the 1940s when it came to fighter-versus-fighter combat. But what of the US-designed and built aircraft themselves, many thousands of which would be used by France, Great Britain and the Soviets in the early war years?

Initially the equipment – especially fighter aircraft – wasn't on a par with that of the Axis powers. By 1943-1944 around a quarter of the UK's arms were from lend-lease.

"Gaining air-superiority relied on many things, not least technical supremacy, better tactics and sheer weight of numbers."

In aircraft terms, the early transport aircraft (such as the ubiquitous DC-3 Dakota) and some bombers and long-range maritime patrol aircraft provided a useful complement to those made by the British themselves, but it was not always so in 1941-1942 when it came to fighters.

Of those sent to the European theatre courtesy of lend-lease, some aircraft possessed usable performance (notably the Curtiss P-40 Hawk family, although these mainly went on to serve with distinction in the Western Desert war where opposition

CHAPTER 1 – AIR SUPERIORITY

ABOVE: ***The Supermarine Spitfire would erode the Luftwaffe's technical superiority in the early years of the Second World War.***

was initially not so fierce) and others not so – including machines such as the Bell P-39 Airacobra and the early versions of the Lockheed P-38 Lightning. Strangely both of these machines were delivered without the turbo/superchargers that increased performance of the types at altitude. In the Airacobra's case only around 80 served with the RAF with other orders being diverted to the Soviet Union or kept for use by the US as the P-400 in Guadalcanal.

The Lightning was also originally delivered without contra-rotating Allison engines to aid commonality with the Curtiss Hawk family in RAF service, which gave it tricky take-off characteristics. Then, despite acrimonious difficulties which saw the UK refuse to take the aircraft and Lockheed push for payment, the USA's declaration of war in December 1941 ended the disagreement when all British Lightnings were subsequently delivered to the US armed forces.

"Eventually it was realised that some form of escort machine needed to go with the bombers all the way to the target, and back."

In the European Theatre of Operations (ETO) updated and new fighter aircraft along with the adoption of proven tactics and greater numbers would win the day, but first a 'new' concept would be tried.

From January 1943, the US adopted what for them was a new concept in the use and application of air power – putting air resources under a single commander and coordinating their use closely with the movements of ground forces. This closely matched the approach used by the RAF supporting the British Eighth Army in the Western Desert.

The Allies formed the American and British Northwest African Air Force (NAAF), which oversaw and helped accelerate the successful advance of ground forces from El Alamein to Tunisia. The theory behind the use of the air force with other services was (from the field manual): "Land and air power are co-equal and interdependent forces and neither should be an auxiliary of the other," adding, "The gaining of air superiority should be the first requirement for the success of any major land operation." Achieving air superiority then would be a given before any invasion of Europe could be contemplated just as it was be gained before the Allied invasion of Sicily in July 1943.

In Europe, the United States Army Air Force's fighter fleet from late 1942 would also learn tactical lessons from the RAF as they took on the (by now) very experienced Luftwaffe. The struggle to achieve air superiority in the West for the Allies would see some dark times for the USAAF. With their belief in the bomber getting through – and eschewing British advice to bomb by night – the Americans initially made deep penetrations into Nazi Germany in daylight without fighter cover – the P-38 and P-47 just didn't have the range.

Eighth Air Force missions against targets such as Schweinfurt, Kiel and Regensburg would suffer heavy losses from German fighters and flak, so much so that following a second raid on both Schweinfurt and Regensburg at the same time, USAAF commanders decided in October 1943 to stop flying unescorted missions. On that dual mission 230 bombers targeted Schweinfurt with a further 146 heading to Regensburg. Thunderbolts could only shepherd the bombers to the western side of Germany and after that the carnage ensued. A total of 60 bombers were brought down, but – with additional losses through damage – it was estimated that 40% of the force that took off from England on the missions were rendered destroyed or unserviceable. Worse was the loss of life suffered by the aircrew on the missions.

The puzzle of how to win air superiority all the way to a long distance target and back had already proven to be a headache for both Germany and Great Britain. With the Luftwaffe's Bf 109 Es being short of range and only having minutes of combat/flying time over south east England during the Battle of Britain, the very same issues had confronted the RAF as they pressed on with attacks over the Channel from 1941.

Initially it was felt that any escort fighter would need to be large and bulky in order to carry enough fuel. The Chief of the Air Staff, Air Chief Marshal Charles Portal even discussed this subject with Prime Minister Winston Churchill. He said: "Increased range can only be provided at the expense of performance and agility. The long-range fighter, whether built specifically as such, or whether given increased range by fitting extra tanks, will be at a disadvantage compared to the short-range high-performance fighter." Portal later

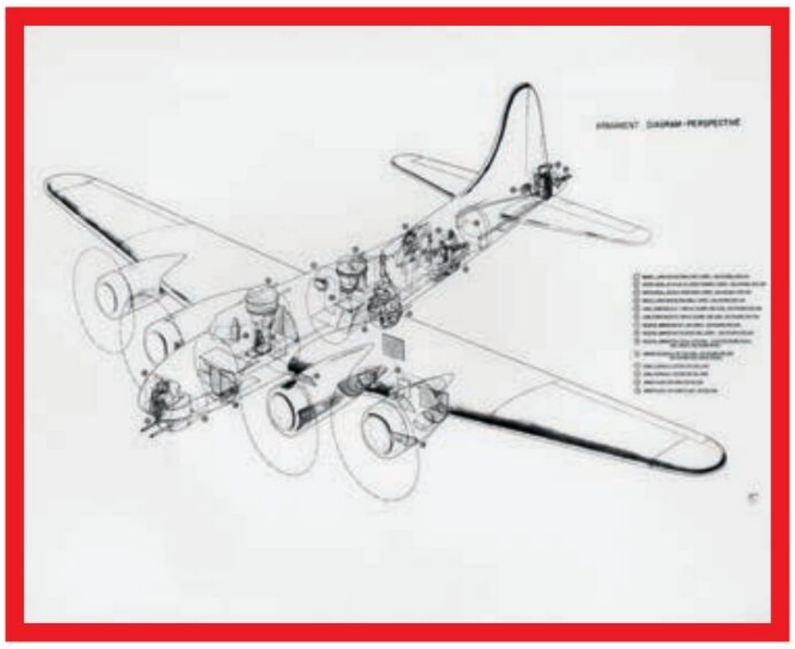
wrote to USAAF General Ira C Eaker: “The proper escort fighter will be a ship exactly like the bomber it is going to escort...”

THE UNSUCCESSFUL ESCORTS

This had already occurred to the United States as they had been looking at some form of long-range escort ‘ship’ themselves. Even a year before the US had entered the war, Lieutenant Colonel Hal George had told General Henry ‘Hap’ Arnold that bombers would need fighter protection all the way to the target. At this time it was felt that such a machine would be some form of ‘gunship’, like a battleship defending a convoy, it would have multiple, not single engines and carry more guns, ammunition and armour.

An answer to this question came in the dubious form of the YB-40 – basically a Boeing B-17 F, fitted with more guns and ammo. The YB-40 featured a twin 0.50 calibre Browning chin turret, staggered waist gun positions with twin ‘50s’ each (instead of the normal single) and a second dorsal turret with twin 50s while the bomb bay carried more ammunition (three times that of a standard B-17 F) and fuel.

Around 30 B-17s were converted and it’s fair to say the experiment wasn’t a success. The 92nd Bomb Group at RAF Alconbury first used the YB-40s on a mission to hit U-boat pens at Saint-Nazaire on May 29, 1943, but



***ABOVE:** The YB-40 was a heavily-armed B-17 ‘escort ship’: the idea failed.*

the YB-40s were slower than the bomber B-17s and slower still after the bombers had delivered their deadly payload. Worse still they were more difficult to fly and sluggish on the controls. The final mission for the YB-40s was on July 29 – just two months later. Five Nazi fighters were downed by the aircraft (with two probables) but soon improvements to the range of the single and twin engine USAAF fighters would provide an answer – even if nothing could really guarantee total air superiority over Nazi Germany’s fighter and flak force.

By now the range of the P-47 and P-38 fighters was improving – thanks to drop tanks. In 1943 the RAF’s Supermarine Spitfire Mk.IX had a range that could only see it push out around 200 miles over France, Belgium and Holland and then make the return journey home. The Mk.VIII version (with extra wing tanks) was earmarked for the larger expanses of the Far Eastern theatre and they took precedence for deliveries of this more refined version, leaving the shorter-ranged ‘stopgap’ Mk.IX to take up the slack and serve in Europe, meaning in this theatre the Spit was always going to lack the required range.

By the time the Thunderbolt was equipping the US fighter groups in the south and east of the UK, a range of around 250 miles was possible, taking the P-47 to the very western edge of Germany itself. This range with a single belly tank (early tanks were either 75 or 108 US gallons or 284/409 litres at the time) meant a reach of around 380 miles, covering cities such as Hanover, Frankfurt and Bremen. By the end of 1943 and early 1944 the P-38 Lightning equipped with twin drop tanks could go further than 500 miles from bases in the UK, which meant that Nuremburg, Leipzig and Stuttgart could be reached.

It was the arrival of a new version of the North American P-51 Mustang that would finally see the bombers all the way to Berlin – and back. Marrying the Mustang’s airframe with the two-stage supercharged Rolls-Royce Merlin engine (replacing the original Allison V-1710 V12) meant that the machine now had the performance at altitude that it needed to stay with the bombers, while placing more

F-15 FACTS

The F-15 was around 11.3 maintenance hours per flight, compared to 24 for the F-4E.

As often is the case, pure fighters – like this Bf 109 E – were pressed into service as fighter-bombers.

CHAPTER 1 – AIR SUPERIORITY

***ABOVE:** With the arrival of the P-51 and drop tanks, the USAAF's bombers could go all the way to Berlin and back with fighter escort.*

fuel tanks in and drop tanks hanging off the airframe gave it the range to stay with the bombers. That range from bases in the UK was around 600 miles with tanks – which meant that P-51Bs, Cs and Ds could now go to Munich and Berlin and back.

In the last 18 months of the war, Nazi Germany was hard-pressed to bring in new fighters – despite leading the way in early jet technology. It was often left to updated versions of existing fighters – such as the Bf 109 G/K and later models of the Focke-Wulf Fw 190 to take on the superior numbers of Allied fighters and even in the last weeks of the war the air defences of Nazi Germany, be it flak or fighters could still take their toll, so total air superiority was arguably never truly gained.

In the Pacific the need for a long-range fighter was even more pressing. Again, like in the ETO American fighters were initially inferior to those of the Axis powers. So, while the likes of the Curtiss Hawk family were hard-pressed to take on a Bf 109 F in the Western Desert, it was similarly the case with various models of Hawk, P-400 and Grumman Wildcats when taking on the agile Mitsubishi Zero in the Pacific theatre.

In the Pacific, tactics were employed to counter the Zero's qualities and new aircraft such as the P-38, Grumman Hellcat, Vought Corsair and later the longer-ranged P-47N Thunderbolt and P-51D would outclass both the (few) new types that the Japanese Navy and Air Force could employ as well as updated versions of the Zero. Similarly – as was the case with the Nazis – by the last year of the war, Japanese pilot quality and training had eroded whereas Allied fighter pilots could be rotated out of the combat area to train the next batch of pilots while the Axis fighter pilots – by now desperately fighting above their homeland – would keep flying until the inevitable happened…

KOREA AND BEYOND

The air war over Korea saw pilot quality and training for UN forces take precedence over any qualitative advantage. At first piston-engine fighters of Second World War vintage would do battle – alongside the early jets – but soon a new, sleek, swept wing shape would be seen in the skies.

The Mikoyan-Gurevich MiG-15 was a shock to fighter pilots when it was first encountered in November 1950, but thankfully the Allies in the Korean theatre had their own swept wing fighter: the North American F-86 Sabre. It could be argued that the MiG-15 had a slight performance advantage over the Sabre (early models could climb faster and had a higher top ceiling) but pilot quality and training eventually told around 'MiG Alley'. The kill ratio was anything between 9:1 and 5.8:1 in favour of the US/UN pilots, while against the elite secret Soviet squadrons comprised of ex-Second World War 'honchos' it was almost equal at around 1.4:1.

Once more the Allies (in this case the United Nations combined air forces) strove to gain and keep air superiority. Once more bombers (this time the B-29 Superfortress) would need to be defended. Major Winton W Marshall, known as 'Bones' Marshall had a unique perspective on this, having taken part in a daylight attack on 30 Tupolev Tu-2 bombers in which Bones guessed that only six or seven survived, he was then involved in a disastrous B-29 escort mission to Pyongyang which would also take place in daylight – despite earlier bombing missions being done at night. Of the 30 or so B-29s, Bones reported that around 12 were shot down. Years later, in the book TOP GUNS he would express his feelings and his comments showed how air superiority had to change in the decades to come. He said: "After Korea I participated

ABOVE: ***The Mitsubishi Zero enjoyed air superiority over the Pacific during the early war years.***

in tests to work out escort procedures and throughout these tests some of the attacking aircraft would get through. The MiGs and F-86s did a good job in air-to-air combat but both types were ineffective in the bomber escort role. It's too damn late to fight the battle in and around the bombers.

The enemy has to be engaged and fought to a standstill a minimum of 100 miles in advance of the bombers' target."

His words would resonate in the coming decades, even if – at the time of the Vietnam War – the US forces were the best-equipped in the world. Unlike their entry into both the First and Second World Wars, decades of development and investment in technology had ensured that the various US air-arms had the most technologically advanced aircraft of the time.

At the tip of the spear was the F-4 Phantom II, which in various guises served both the USAF and USN. When fully loaded

F-15 FACTS

The Eagle would be the first 'pure' fighter aircraft to use a HUD or 'Heads Up Display.'

BELOW: ***Even the early German jets like the Me 262 couldn't wrest air superiority from the Allies at the end of the Second World War.***

CHAPTER 1 – AIR SUPERIORITY

not necessarily drop dumb bombs on trucks and bridges, let alone shacks or sampans.

Despite the lack of a clear air superiority fighter in-theatre in Vietnam (save, arguably for the few-in-number F-8 Crusaders, more of which later) the Phantom could and did perform the air superiority role, often in spite of the hated 'Rules of Engagement' or ROE.

If ever a set of regulations would hamper an air superiority fighter it would be these rules. Of course, this had occurred a decade and a half before. In the Korean War F-86 pilots often engaged in combat with MiGs over Manchuria, despite rules to the contrary. Worried about an expansion of the conflict, United Nations pilots were told to let fleeing MiGs go when they left MiG Alley, heading north over the Yalu river towards their Chinese safe havens. Sometimes by accident, but often deliberate, it's now known that many pilots followed their prey and many dogfights occurred over territory that was 'off limits' to UN aircraft.

Also, these combats took place in common knowledge of unit commanders and even as a direct result of their orders. It's thought that more than a reel or two of gun camera footage was exposed and thus rendered useless after the F-86s returned to base and actual kills would go unclaimed…

In Vietnam the ROE were even more expressly hated, but – this time – were pretty well adhered to, for fear of enflaming the conflict still further. ROE often meant that certain targets could not be attacked (such as airfields) or air-to-air targets could not be engaged until a positive identification could be made. Politics – it seemed – ruled tactics and strategy to the detriment of actual results.

Other things were affecting results: the lack of positive ACM or Air Combat Manoeuvres training. Legendary Second World War ace Colonel Robin Olds took over command of the 8th Tactical Fighter Wing at the end of 1966 and felt a lack of success in-theatre was as much about tactics as politics. He felt there had been – for too long – a lack of ACM training. Instead, safety was stressed too highly especially when those higher up the chain of command would believe the brochure claims of the latest missiles with 20 mile ranges and 100% kill probability.

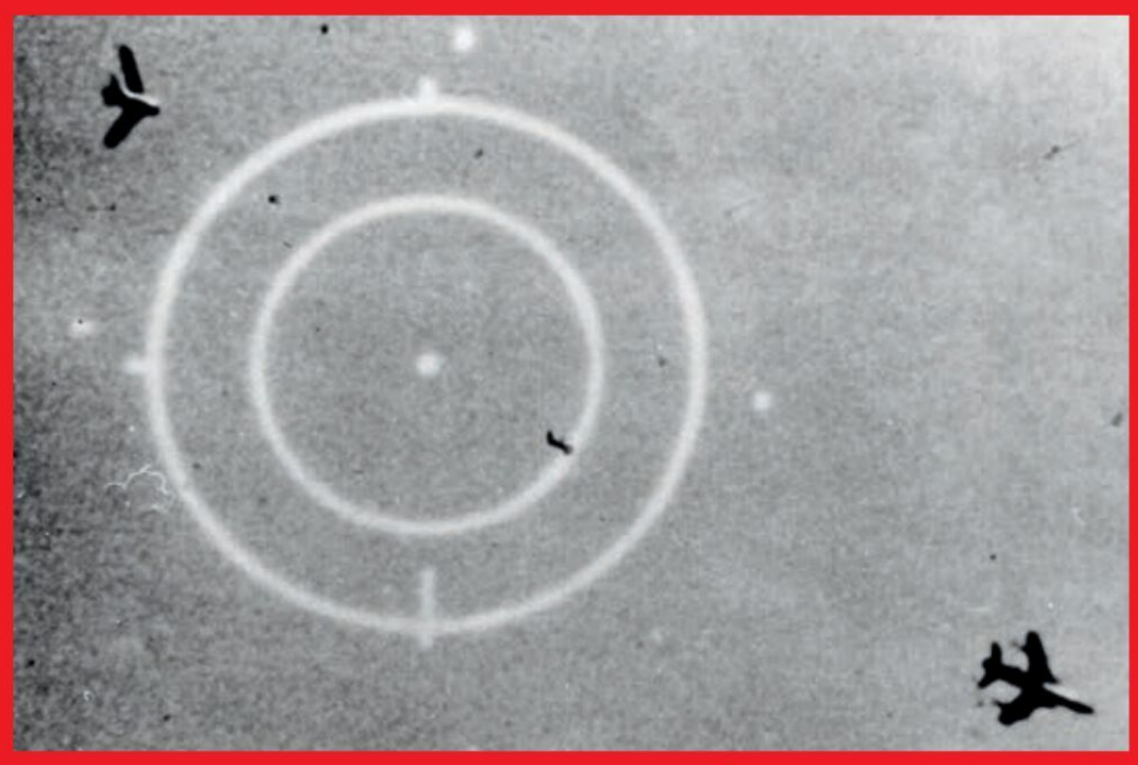
By the time Olds was out front and leading the 8th TFW or 'Wolf Pack' (he started out as 'Green 16' until he learnt the ropes) the big F-4Cs and Ds were up against smaller, lighter, harder-to-see and better manoeuvring MiGs which often held all the advantages – and therefore denied the USAF and US Navy air superiority.

Olds – a 12-kill ace from the Second World War – was let in on a plan being hatched by some of his most experienced pilots: Captain John B Stone, 1st Lt. Joseph Hicks, 1st Lt. Ralph F Wetterhahn and Major James D Covington. Together they came up with Operation Bolo, an exemplary piece of strategy, where – on January 2, 1967 – the F-4s masqueraded as heavily-laden F-105s, luring up a force of MiG-21s destroying seven of them (five admitted by the Vietnamese). It was a great piece of tactical planning, where the F-4s even used call-signs and ECM pods utilised by the Thuds. For that

> ***"Korea saw UN/USAF pilots hold the line when it came to kill-ratios against the Koreans, if not the Soviets."***

F-15 FACTS

HOTAS or 'Hands On Throttle And Stick' was a way of the Eagle pilot keeping his hands on the controls while using the radar and other systems.



ABOVE LEFT: ***Old hands like Colonel Robin Olds would use shrewd tactics to take four MiG kills in Vietnam.***

ABOVE RIGHT: ***At least the Thud had a gun! MiG-17 chases F-105 as seen through the sights of another Thunderchief.***

BELOW: ***North American F-86 Sabres would take their toll of Communist MiG-15s in Korea.***

moment at least, it gave the Wolf Pack air superiority over the Vietnamese air force.

In comparison the United States Navy was still teaching ACM, even if the machine that was becoming dominant on the decks of the US carriers from the late 1960s – the F-4B, G and J model Phantoms – also didn't have an internal gun, just like the F-4Cs and Ds of the air force. The lack of a cannon on the primary US fighter would not lend it to the air superiority role, even if two aircraft in the Navy and Air Force's inventory did have guns: the Navy's F-8 Crusader family and the USAF's F-105 Thunderchief. Both would score kills as would USAF F-4s carrying a podded M61 20mm Gatling-type cannon and score kills before the definitive F-4E with an internal cannon saw combat towards the end of the conflict.

Admiral Paul Gillcrist flew everything from the F6F Hellcat of the Second World War to the Grumman F-14 Tomcat. He went on record as saying that the F-8 Crusader's 6:1 kill ratio in the early part of the Vietnam war came despite some tricky handling characteristics but it seems clear that the relative success of the Crusader compared to the early efforts with the F-4 Phantom come from the training differences between the various cadres. With the F-4 specifically using and training with beyond visual range (BVR) AIM-7 Sparrows, it was a question of head-on intercepts, while the Crusaders – armed only with AIM-9B Sidewinders and four 20mm cannon utilised these weapons in their training and therefore were adept at old-school dogfighting tactics.

Overall then, in Vietnam the kill ratio had slumped to as little as 1.5:1 if you believe certain sources – but again statistics muddy the waters, with many of the kill ratios comparing all kills against all US aircraft, be they fighters, bombers or unarmed observation planes.

Therefore the more accurate kill ratio could be as high as 3.8:1 for the USAF for the entirety of the conflict (all aircraft) and up to 5.5:1 for fighter-versus-fighter combat. For the US Navy some stats show a 4.7:1 ratio for all aircraft during the entire war and 6.4:1 for fighter-versus-fighter combat.

Whatever figures were correct, any future air superiority aircraft would have to clear the skies at long range, medium range and close range and survive. The air superiority fighter of the future would have to be a dedicated killer.

F-15 FACTS

The Eagle has scored more than 100 kills for zero losses since entering service.

LESSONS OF AIR SUPERIORITY

Superior aircraft, numbers, weapons, tactics, superior situational awareness and simple rules of engagement…

SUPERIOR AIRCRAFT

To win air superiority, it helps if you have a technological advantage over your foe. History has ever proved it thus – with notable exceptions, of course. Think of 1915-1916's Fokker Scourge, where the new Eindecker monoplanes of the Imperial German Flying Corps were superior to machines fielded by the Allied air forces. Eventually the introduction of the Airco DH2 'pusher' biplane and the French Nieuport 11 turned the tide.

The same happened in the Second World War and Korea. The Luftwaffe was only held when equipment of some parity (Hurricanes and Spitfires) could take on the Messerschmitt Bf 109 on relatively equal terms: even considering the advantage of better tactics employed initially by the Nazis. Then – in 1942 – the new Focke Wulf Fw 190 meant that the RAF began to lose the struggle for air superiority on offensive operations over northern France – at least until the Spitfire Mk.IX replaced the hard-pressed Mk.V. It was a similar story in the Pacific war with the Japanese Mitsubishi Zero, while in the Korean air war until the arrival of the F-86 Sabre the straight-winged Lockheed F-80 Shooting Stars and Grumman F-9F Panthers were at a serious disadvantage. And the F-86 only gained a clear margin of superiority when the all-moving tailplane of the F-86E resulted in better high-speed agility.

In Vietnam, the United States occasionally lost air superiority to inferior aircraft thanks to tactics or the rules of engagement which sometimes meant they were taking long-range missiles to a gunfight…

SUPERIOR WEAPONS

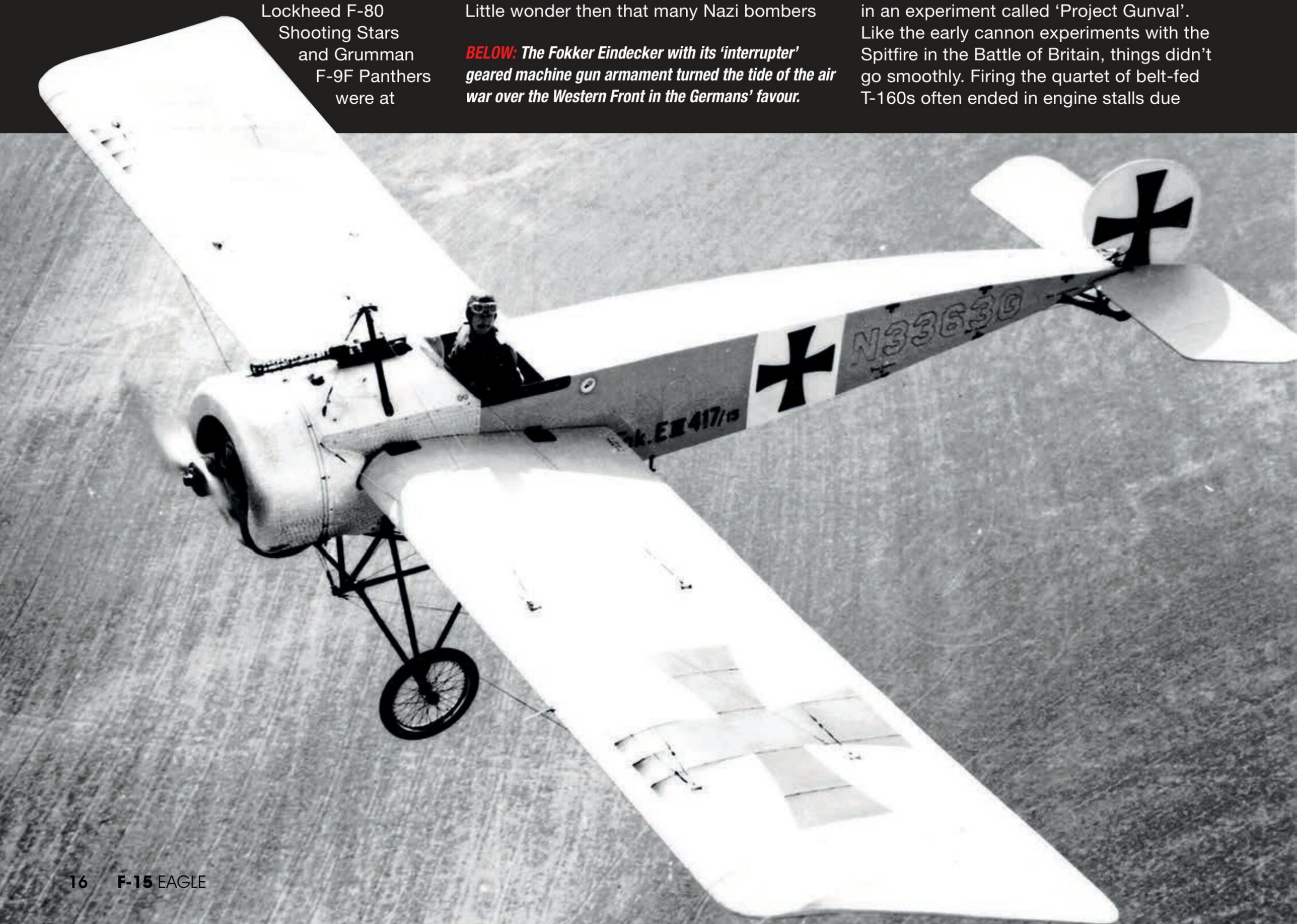
The actual weapons carried by aircraft have also been a big part of how to establish air superiority. Back in 1915 the weapon that made the Eindecker so deadly was the machine gun: a machine gun that could fire through the propeller arc thanks to the use of an 'interrupter' gear, which only allowed bullets to only fire when they would be clear of the propeller blades. Early in the Second World War, the use of heavy machine guns and cannon on Luftwaffe aircraft meant that their firepower out-ranged the RAF's smaller-calibre eight-gun aircraft and had more punch. A comparison test on a Bristol Blenheim airframe undertaken by the British showed that a 20mm round weighed about 12 times as much as a single 0.303 round… Little wonder then that many Nazi bombers would still be able to limp back to their bases in northern France despite being riddled with 0.303in (7.7mm) bullet holes.

Early experiments during the Battle of Britain with a number of 19 Squadron Spitfire Mk Is armed with 20mm cannon were fraught with problems and it wasn't until after the battle that later marks of Spitfire were so armed – albeit with notable exemptions, such as Douglas Bader's Mk.VA Spitfire, still with eight 0.303 inch weapons as he wanted to 'get in close' to ensure a kill!

So, the introduction of heavier calibre weapons on RAF and USAAF fighters during the Second World War such as the 0.5in Browning and the Hispano and Oerlikon drum-fed 20mm cannon would redress the balance, but – once more – in the skies over Korea the F-86 Sabres and their six 0.5in Brownings would find themselves out-ranged and out-gunned by the enemy.

The enemy was the tough MiG-15 with its two 23mm and single 37mm cannon with far greater hitting power than the six Brownings. Eventually, in 1953 – and similar to the RAF's 20mm cannon experiment in the Battle of Britain – eight F-86Es and Fs would be fitted with four T-160 20mm cannon in an experiment called 'Project Gunval'. Like the early cannon experiments with the Spitfire in the Battle of Britain, things didn't go smoothly. Firing the quartet of belt-fed T-160s often ended in engine stalls due

BELOW: ***The Fokker Eindecker with its 'interrupter' geared machine gun armament turned the tide of the air war over the Western Front in the Germans' favour.***



to gas ingestion into the air intake or belt/ammo jams under G-loads, the latter an issue that had occurred in fighter aircraft since the first machine gun was taken aloft…

Looking back over the history of the development of air-borne weapons, it's also often been the case that only testing under combat conditions counts.

Early machine guns and cannon would often perform perfectly during testing but in combat things were often different. Early Merlin-powered P-51 Mustangs had issues with guns jamming until the layout of the weapons and heating for the gun bays was sorted. During the pre-combat Gunval tests with the four-cannon F-86 Sabres the test pilot George Welch carried out a successful raft of tests, but – when the aircraft were subject to the higher altitudes of combat, gas ingestion led to compressor stalls and high G-loads led to two of the four guns jamming. In combat over Vietnam, the Vought F-8 Crusader would also suffer jams in one or more of its four Colt Mk 12 20mm cannon in turns of more than 3.5G.

In the missile age things seem to have worsened. Advertised ranges of missiles, their performance and kill probability would be trumpeted by those manufacturing the weapons and the pilots carrying out the early testing, but often these tests would be under less exacting conditions than combat. Added to that, the missiles may be designed to take down large bombers (not fighters) they would be tweaked and brand-new, not having been subjected to daily use (think about what missiles go through during multiple carrier landings before eventually – if ever – being used in anger) and their targets would often be slow, obsolete target aircraft often stooging around at altitude, with everything set in the attacking aircraft's favour and with hardly any Gs put on either aircraft.

Compare that to using one during the Vietnam War. You're trying to set-up a Sparrow shot under high-G, against a highly agile fighter-type target, at low-level with considerable radar ground clutter… Little wonder the kill ratio for the original Sparrow medium-range radar-guided air-to-air missile has been quoted as being as low as 8-10%, very different from the 80-90% Pk (Probability of Kill) in development testing.

***ABOVE:** Against missile-only armed Phantoms, the MiG-17's agility and close-in cannon armament often proved deadly.*

SUPERIOR TACTICS

Throughout the history of air warfare this has been the case. The use of better tactics than the enemy can see a smaller or less well-equipped air force do better than a larger, more technologically advanced one. The Vietnam War is a case in point and made the US move to a 'train as you fight, fight as you train' doctrine and the various Flag training events. It works.

SUPERIOR SITUATIONAL AWARENESS

Knowing what is happening around you gives you what pilots call the 'big picture' of the 3D battlefield and how it links with various ground elements. This goes far beyond what you see out of the cockpit. Many great leaders of the air have had this knack of knowing what is going on, even if they didn't compile big scores themselves.

An example of this in the Second World War was beautifully illustrated by the great Robin Olds. Frustrated by his intelligence officer Don Horton and his constant badgering for information after each flight, Olds takes him up in a 'piggyback' two seat P-38 Lightning. By disorienting Horton with some manoeuvres Olds actually crossed the North Sea and pretended to do a mock attack on a train. "See that train down there?" said Olds. "Here's how we set up for a strafe pass…" When Olds let rip with 50 calibre and 20mm fire the expletives from the back cockpit were indicative of Horton's utter shock. The pair flew home in silence and when on the ground Olds made his point to the intelligence officer: "Okay Don, what was our take off time? Where did we cross out? When and where did we go feet-dry over the continent? How many trucks were in that convoy we passed? Show me on the map… where did we pick up the flak?" Olds was showing Horton the many things that a good pilot has to be aware of in battle. These skills would serve Robin Olds well during both the Second World War and Vietnam.

Today the pilot has many aids to help his or her situational awareness. It's gone from the hand signals and wing-waggles of the First World War through to radio communication all the way to today's IFF equipment (Identification Friend of Foe) AWACS and JSTARS (Joint Surveillance Target Attack Radar Systems) battle management aircraft and linked information between air and ground forces. Each element aims to give the pilot a better idea of the battlefield, so that they have the advantage.

SIMPLE RULES OF ENGAGEMENT

"The fighter pilots have to rove in the area allotted to them in any way they like and when they spot an enemy aircraft, they attack and shoot him down: anything else is rubbish."

So said Manfred von Richthofen, known as The Red Baron and he's still correct to this day. Making it easy for the fighter pilot to do his job hasn't often been the case – look at the Rules of Engagement mentioned above in both the Korean and Vietnam wars but things would eventually change…

In fact, all of these rules would come together in Operation Desert Storm and Operation Iraqi Freedom and the fighter at the tip of the spear in these operations would be – the McDonnell-Douglas/Boeing F-15 Eagle.

CHAPTER 1 – AIR SUPERIORITY

ABOVE: Current air-dominance is expressed by the Lockheed-Martin F-22 Raptor: but with so few purchased, could a new 'F-15X' buy be on the horizon?

LEFT: US air superiority in Desert Storm: F-16 Viper, F-15C 'Albino' and F-15E Strike Eagle.

BELOW: After the Sabre, North American's Super Sabre ushered in the era of supersonic fighters.

> ***"Air-superiority or even 'air-dominance' was the aim of any air force about to be engaged in battle. For this a number of stars had to align and one of these was that you would need to field the best fighter available..."***

THE 'OTHER' AIR SUPERIORITY EAGLE

Decades before the McDonnell Douglas F-15 Eagle was even on the drawing board, there was a previous holder of the name that was originally hoping to secure 'air superiority' for the United States Army Air Force all the way to a target and back.

In the autumn of 1942, the Fisher Body division of General Motors began to design an aircraft which would be able to climb quickly to operational altitude. According to the USAAF's issue of proposals, this aircraft was to possess a high climb rate so it could reach fighting height quicker than the enemy: lessons learned from the Battle of Britain. In October 1942, Fisher was awarded a contract to build and develop two prototype XP-75s which would later be called the P-75 Eagle.

This aircraft was – in effect – a 'bitsa'. The airframe used parts from the Vought F-4U Corsair (landing gear), P-40 Warhawk outer wing panels (later changed to P-51 Mustang items) and the tail from a Douglas SBD Dauntless (later refined.) The design had a mid-engine – similar to the P-39 Airacobra and two contra-rotating propellers. Power came from the Allison V-3420-19, a 24-cylinder 'double V' engine rated at 2800hp – the most powerful liquid-cooled inline motor then developed in the USA.

The first aircraft flew in November 1943 with six XP-75s being built for testing during 1943/44. Despite much refinement (new tail, 'bubble' rather than 'bird-cage' canopy) issues included the centre of gravity for the aircraft which didn't help the machine's spin characteristics and poor engine cooling (improved during flight testing eventually).

By the time the aircraft entered testing, the need for long-range fighters in the ETO was most pressing, so six more XP-75s were modified for a long-range escort role. An order for 2500 was placed – but cancelled when it was clear that existing, developed and proven aircraft such as the P-51, P-47 and P-38 could take the role. The P-75A Eagle project was effectively terminated in October 1944, only eight XP-75s and six production P-75s were completed.

The Eagle's performance was a 433mph top speed at around 25,000ft, a more than 2000 mile range and a service ceiling of more than 35,000ft. Armament would have included ten 0.50in Brownings (six in the wing, and four in the fuselage) and potentially bombs and rockets.

ABOVE: The Fisher XP-75 Eagle was designed as an air-superiority fighter but never saw service.

FLEDGLING FIGHTER

Fashioned at the Pentagon following the unveiling of contemporary Soviet designs and honed by the battles over Vietnam, the F-15 Eagle was to become a no-holds barred air-to-air fighter, but it was a long road to that first flight...

The two McDonnell Douglas fighters in the air: the F-4E was a real multirole fighter-bomber coming from what was originally a fleet air-defence interceptor. Meanwhile the F-15A was originally designed as a pure air superiority fighter – with some latent air-to-ground capability under the skin. It too would eventually become a mud-mover…

F-15 FACTS

Around 1700 F-15 Eagles have been manufactured since the early 1970s.

CHAPTER 2 – FLEDGLING FIGHTER: PHANTOM TO EAGLE

Many different outside forces were acting on the United States of America's military procurement machine in the decade before the F-15 Eagle's entry into service.

Firstly, the cost of development and procurement of high-profile weapons systems had been under close scrutiny since the early days of the Kennedy presidency in the early 1960s: John F Kennedy took office in January 1961, bringing with him Robert Strange McNamara.

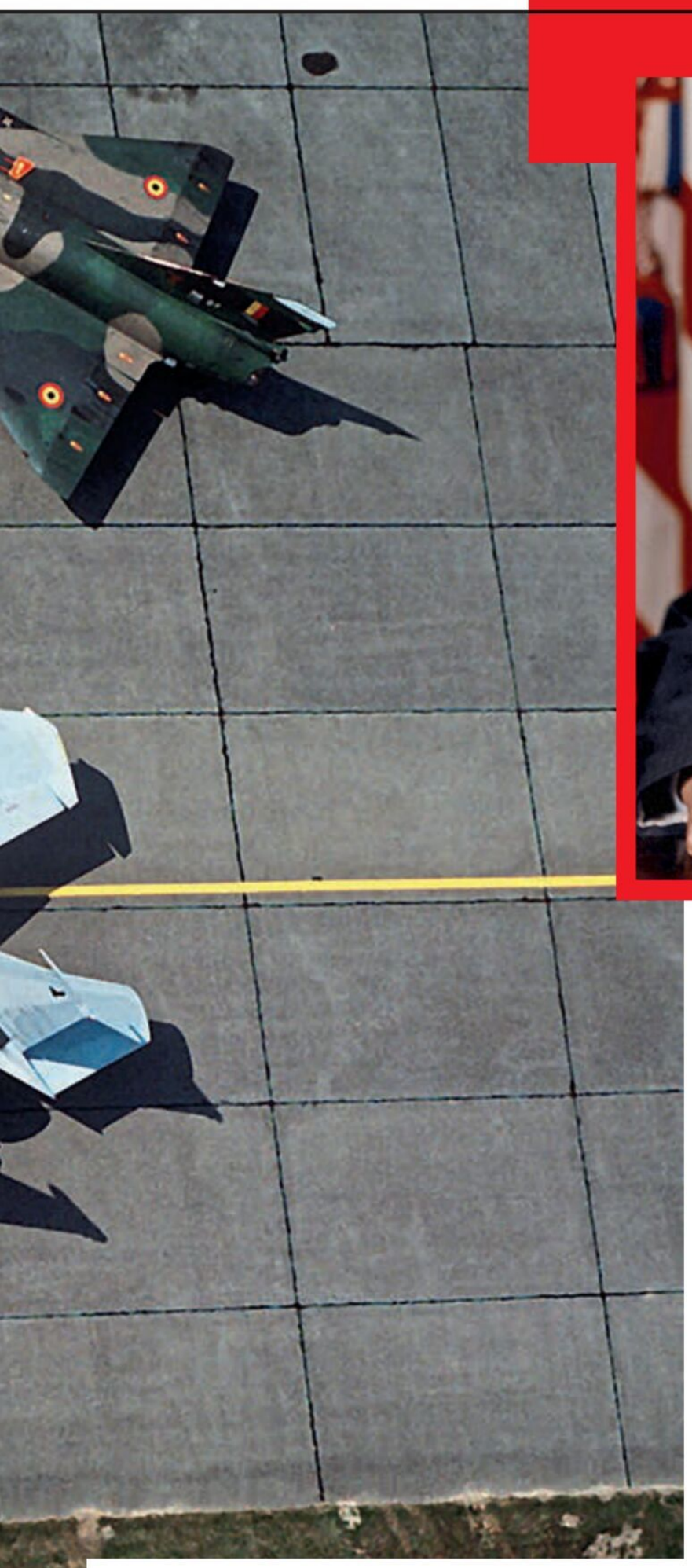
McNamara's background was business school before he became a captain in the United States Army Air Force in 1943. His work during the conflict was in the Office of Statistical Control, basically increasing the effectiveness and efficiency of the late war bombers (getting them to sometimes double as transport aircraft as a consequence) in the Far Eastern theatre of war.

***ABOVE:** A telling shot shows an RAF Phantom, next to the F-111, Eagle and Belgian Mirage. The F-111 'swing-wing' aircraft was supposed to be a fighter and a bomber at first.*

Connections made during wartime helped McNamara get a job with the Ford Motor Company in 1946. This job led to McNamara and nine others initially being called the 'Quiz Kids' for all the questions they asked of the old hands on the shop floor and above as well as their comparative youth to that of the Ford board. Soon this was changed to the 'Whiz Kids' and they – led by McNamara – basically restructured Ford and also looked at what products it made. At the end of 1960 Robert S McNamara became the first president of the Ford Motor Company who wasn't a member of the Ford family.

But bigger things lay ahead. Within a month of taking up the job at Ford, JFK had offered McNamara a range of jobs in his administration – he chose defence – and his job was to ensure that the Kennedy administration got the best value possible for the defence dollar.

One way of doing that was to have some sort of commonality between the services and so in September 1961 it was decided that an aircraft would be developed to fulfil both the Air Force's tactical fighter role and the Navy's fleet defence role. What came from this idea was the Tactical Fighter Experimental programme (TFX) but – despite the logical idea of a common airframe to keep costs down – the conflicting needs of both the tactical role and that of a fleet interceptor seemed insurmountable: at least in the heads of USAF Generals and USN Admirals. And this was before designs were submitted or even metal cut…



***ABOVE:** Robert McNamara brought business sense to military procurement: but did it always work?*

> ***"The 'jack-of-all-trades' F-111 would eventually be anything but. A failure in the fleet interceptor role, it would eventually mature as a capable strike aircraft."***

The winner of the TFX competition was announced at the end of 1962 as General Dynamics, operating out of Fort Worth, Texas. The aircraft designed and built for these roles was to become the F-111. In USAF guise it would be a variable-geometry (or 'swing wing') nuclear and conventional interdictor while (with Grumman's help) the F-111B would be a long-legged fleet interceptor, armed with a new breed of ultra long range air-to-air missiles.

Cutting a long and painful story short, during sea trials it was found that the F-111 was too big and too heavy to be a fighter or interceptor of any real use to the Navy.

Their variant had first flown in 1965 and a series of development issues – including with the Pratt & Whitney TF-30 engines and fatal crashes – marred the programme. Also, the costs had tripled. Little wonder deck crews had nicknamed it the 'Sea Pig'. The F-111B project for the Navy was finally killed in 1968 when – during a congressional hearing concerning the project Admiral Tom Connolly made his famous statement: 'Mr Chairman, all the thrust in Chistendom wouldn't make a fighter out of that aircraft.'

Around $400 million had been spent on the F-111B alone but thankfully the engines and weapon systems were used as the basis for the US Navy's F-14 Tomcat while the USAF's F-111 variants (FB-111A, F-111A, D, E, F and EF-111 Raven 'Spark Varks') served the US well into the 1990s with the Royal Australian Air Force buying the F-111C version which served until 2010.

This turn of events with the Navy's F-111 and the maturing USAF version initially didn't look good for the government of the day or General Dynamics. While the strike-fighter version would mature into a fine aircraft, the first combat deployment in 1968 was perhaps too much too soon for this innovative aircraft. Three from the original six deployed were lost within the first month, due to issues with their horizontal stabilisers, rather than enemy action. It would be another three years before the F-111 was declared fully operational and – as fine an aircraft as it became – it was also hampered by its original 'Jack-of-all-trades' design and, while it was capable as a nuclear armed strike-fighter, initially a 'conventionally armed' F-111 with a full load of Mk.82 iron bombs wasn't capable of flying higher than around 16,000ft. This – alongside improvements in Soviet surface-to-air (SAM) missile systems – led to the F-111 becoming a low-level strike aircraft.

By now McNamara was gone to a new job at the World Bank. His legacies included that of being (still) the longest-serving Secretary of Defence, serving from 1961 until 1968 under both Kennedy and his successor Lyndon Johnson. Another legacy that lived on after he'd gone was the culture he fostered of attempting to keep costs down: sometimes this bore fruit, such as almost forcing the USAF to employ the Navy's F-4 Phantom II and during the UN Navy's search for a replacement for the venerable Douglas A-4 Skyhawk light-attack aircraft.

A request for Skyhawk replacement proposals required that they be based on an existing airframe. Strangely (and cheekily) the Vought team put forward the A-7 Corsair II, which any plane-spotter could see only shared the basic shape of the F-8 Crusader and very few common parts! Following the Navy's successful debut of the A-7A into combat over Vietnam in 1967, the USAF quickly adopted its own version – the A-7D – for its own tactical role over South East Asia, more on which below…

THE LESSONS FROM PREVIOUS WARS AND VIETNAM

As we've already discussed, the lessons re-learned in the skies over Vietnam were hard-earned.

Just before the conflict, the USAF was expecting to have a general 'mix' of the F-111 and the F-4 Phantom II for the 1960s and beyond. In 1963 'Project Forecast' was a paper which set out to identify future requirements for the USAF. In it, General Bernard A Schriever of Air Force Systems Command said that fighter needs in the 1970s would be best met by the F-111 and F-4 variants: "Optimised for the air-superiority role… and that strategic bombing from aircraft able to fly higher and faster than the enemy would ensure air superiority." Project Forecast added: "… the counter-air force must be able to destroy aircraft in the air." So, any in-bound attackers had to either defend themselves or have the appropriate cover.

Around a year later in 1964, Major General Arthur C Agan was becoming frustrated that many in The Pentagon believed dogfighting and the use of guns on aircraft was an anachronism: as a former P-38 Lightning pilot in the Second World War, Agan didn't think this was the case

F-15 FACTS

After a mid-air collision, one F-15 made it back to base, flying on just ONE wing!

and argued the case in favour of keeping guns as a fighter weapon. In the autumn of 1964 he presided over a committee of former fighter pilots to look at the USAF's then-current tactical capabilities.

It was hoped that at the very least they could use the findings to push the case for an internal gun in any future version of the USAF's F-4C. The committee was eventually chaired by Brigadier General Harrison Thyng (Second World War and Korean War ace), Colonel Francis 'Gabby' Gabreski (also an ace in both those conflicts), Brigadier General William Douglas Dunham (a triple ace in the Second World War) and other former air-to-air veterans.

Understandably, this group of famous old fighter jocks came to the conclusion that a new fighter should be developed to counter the Soviet's increasing capability in this area. By this time it was known that more modern versions of the MiG-21 were in development, much more advanced than the early models which were based on the basic airframe which first flew in 1956.

Initially the group's findings fell on deaf ears, but in early 1965 the incoming Chief of Staff – General John P McConnell – urged Agan to draft a statement on tactical air superiority. This was finally circulated all across the USAF's chain of command in May 1965 – just as combat operations over Vietnam had begun…

While this was happening, Lieutenant Colonel John W Bohn Jr. had been tasked – since the previous August – to produce a study entitled: 'Force Options for Tactical Air'. This report critically assessed the USAF's reliance on high-performance tactical fighters to provide: "…the greatest flexibility at the lowest cost." Things were starting to come to a head, as – around the same time – it was becoming obvious that the TFX/F-111 was purely a strike aircraft and when this became clear, some of the top brass – convinced by Bohn's findings when the study was completed at the end of February 1965 – wanted to move to a 'high-low' mix of low-cost fighter-bombers with expensive, more capable ones.

The low-cost elements were a way of strengthening the USAF by sheer weight of numbers. Existing aircraft looked at included many different versions of various existing aircraft, including the F-4, the

"Numerous committees were created and reports drafted during the 1960s which helped come to the conclusion that the USAF needed a dedicated fighter."

Douglas A-1 Skyraider, Grumman A-6 Intruder and F-104 Starfighter – although by now it was accepted that the Starfighter was nothing other than an export success rather than a tactical USAF one.

Eventually this 'low' mix came down to two designs. The first was initially going to be a higher-specification version of Northrop's F-5, which was proving popular in the export market, while the other was to be a land-based version of the Vought A-7 Corsair II, which – while not as effective as the agile F-5 in the fighter role – could carry a much higher payload and was already proving its worth in the US Navy as an accurate strike aircraft.

Arguments went to and fro as to what aircraft would best fit the bill – and other arguments came about as to what future 'premier' fighter could guarantee the survival of any new aircraft. As was often the case, yet another Air Staff study was made – under the direction of Colonel Bruce Hinton (a former Korean War ace)

ABOVE & LEFT: ***Some of the impetus for the F-X/F-15 programme came thanks to the Soviet's MiG-23 and MiG-25 aircraft, revealed in 1967.***

looking at a future 'Tactical Fighter Ground Attack Aircraft'. This ended in 1965 with the A-7 Corsair II as overall winner. History would show that the F-5 would be employed in the aggressor/adversary role for the USAF, while the A-7 would go on to have a long and fruitful USAF career, coming into use in 1970 and departing the last Air National Guard units to operate it in 1993.

These studies and counter-studies, arguments and counter arguments showed the way the system was in the United States and in The Pentagon during the 1960s: confusing, to say the least. What ultimately was decided from these studies was that the more capable, more expensive fighter was to be labelled F-X and this was to become the F-15, although even then the specification of the aircraft was to change this way and that as the arguments ebbed and flowed.

Initially it was going to be a multirole aircraft, then a pure fighter; also the size/weight of the aircraft would change. Meanwhile, the air war over Vietnam was showing a real need for a pure air superiority aircraft. On April 4, 1965, two bomb-laden Republic F-105 Thunderchiefs were shot down by supposedly 'obsolete' Korean War vintage MiG-15s.

So – as the decade wore on – both the USAF and US Navy would find themselves equipped largely with a fast, powerful but none-too agile interceptor, equipped solely with air-to-air missiles (F-4 C/D and B/J Phantom IIs) which were expected not only to be employed in the strike/attack role, but also actually dogfight with smaller, more nimble gun-toting MiG-17s, 19s and 21s. Meanwhile the fighter-bombers were even harder pressed – especially in the face of localised fighter opposition when they flew without escort.

SOVIET SUPREMACY?

The 'West' had felt that its military aircraft had the edge on anything designed by the Soviet Union, probably since the Spanish Civil War of the 1930s. There, in clashes in the skies above, rotund Polikarpov I-16 'Ratas' of the Republicans would take on the sleek Messerschmitt Bf 109s of the Nationalists.

However, this well-known image is not a particularly good reflection of the reality. The Polikarpov I-16 itself featured some modern touches for an aircraft that first flew in 1933 (monoplane, retractable undercarriage) and this pointed the way to more advanced designs from the Soviets as years went by.

By the time the Nazis had been held on the ground following Operation Barbarossa, Soviet designs were moving forward apace and mid to late war designs such as the later Yaks and LaGGs were at least the equal of anything from the West – at lower altitudes.

In the Korean War the Soviets shocked the world with the debut of the swept-wing MiG-15 in combat and from then on until the late 1970s the Mikoyan-Gurevich design bureau was in the ascendancy.

The MiG-21 'Fishbed' first flew in 1956, but it was advanced versions of this aircraft that were beginning to worry both the USAF and the Pentagon in the early 1960s. With current versions of the F-4 Phantom II finding it sometimes hard going against the Fishbed Cs of the North Vietnamese Air Force, the second generation of MiG-21 – the PF – which stood for Perekhvatchik Forsirovannyy (Interceptor Uprated) was already flying in Russia. This second generation of Fishbed had enhanced avionics and sensors, radar-guided air-to-air missiles and uprated Tumansky R-11 F2-300 turbojets. Worse, MiG was already developing a version of this model, the MiG-21 PFL for use solely by the Vietnamese. As well-trained and superbly flown as the existing F-4C and D models of Phantom II were over Vietnam any qualitative edge the Americans may have had in general over the Soviet-built fighters was being eroded.

In 1967 the western world was shocked by the first sight of a number of new Soviet fighter aircraft. At the Domodedovo air pageant of July 1967, both the MiG-23 and MiG-25 made their debuts alongside the Su-15 'Flagon' interceptor and Su-17 attack aircraft. The West saw that the MiG-23

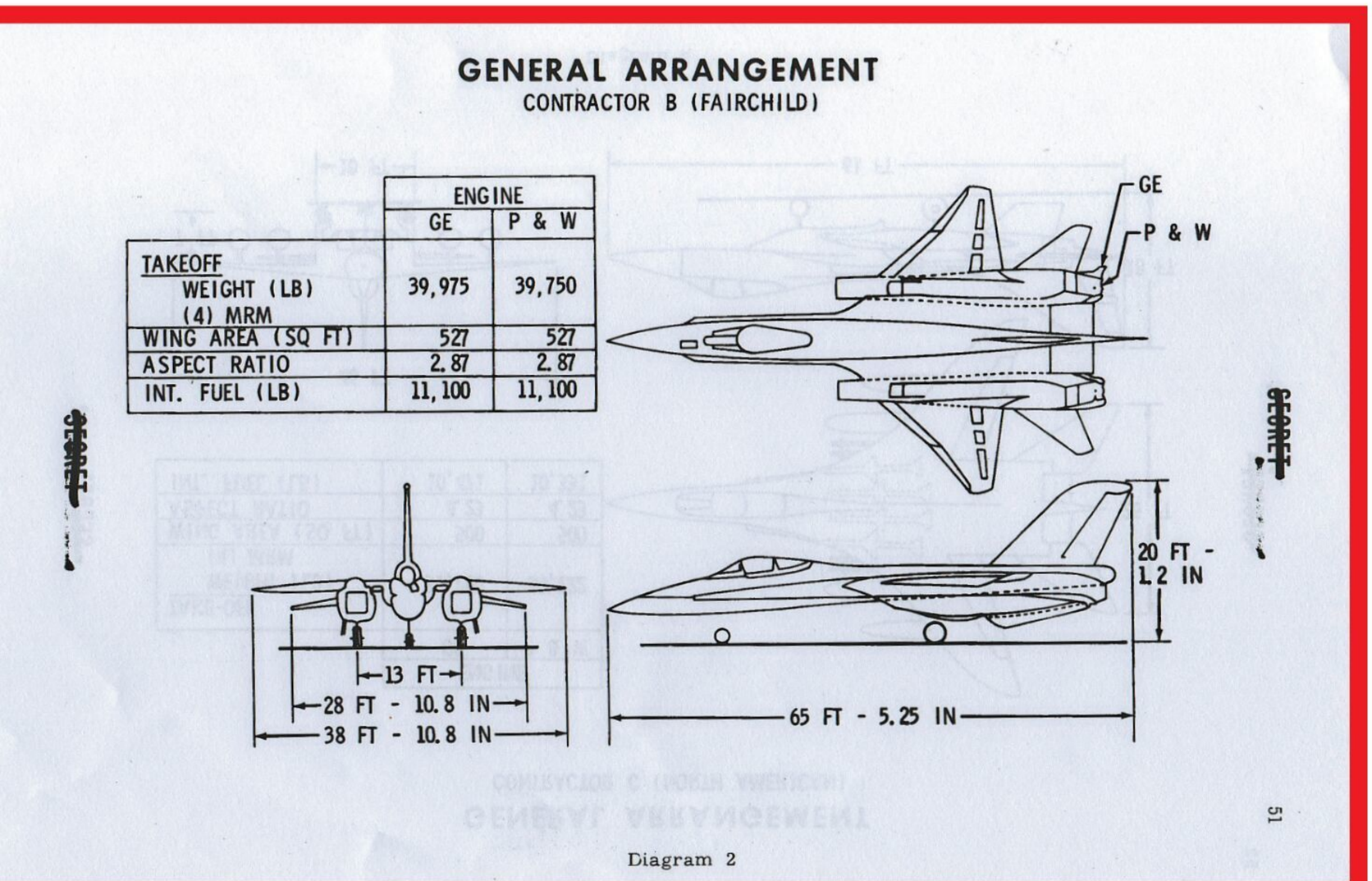


Diagram 2

followed the likes of the F-111 by employing a 'swing' wing to handle the differing needs of slow speed for landing and dogfighting and high-speed for the intercept role.

The MiG-23 was a single engine aircraft while its sibling used two, huge Tumansky R-15 turbojets, giving a maximum theoretical speed of Mach 3.2. The MiG-23 was named 'Flogger' under US/NATO coding while the MiG-25 was christened 'Foxbat'.

As was usual back then, the knee-jerk reaction was to overplay the projected performance of these fighters: besides, this was good for defence spending! The Foxbat was actually a Soviet response to the cancelled North American B-70 Valkyrie – a Mach 3 bomber – which was cancelled in 1961 but still flying in the mid-1960s as the XB-70 test-bed. And, although it did reach Mach 3.08, it never routinely flew above Mach 2.5.

At first US intelligence considered that both these new MiG types were probably

ABOVE, BELOW & RIGHT: ***The three F-X contenders would be Fairchild, North American and McDonnell Douglas. All three were very different – but all had a 'blown' clear-vision canopy.***

F-15 FACTS

A 'navalised' version of the F-15, called the F-15N, was considered for use by the US Navy.

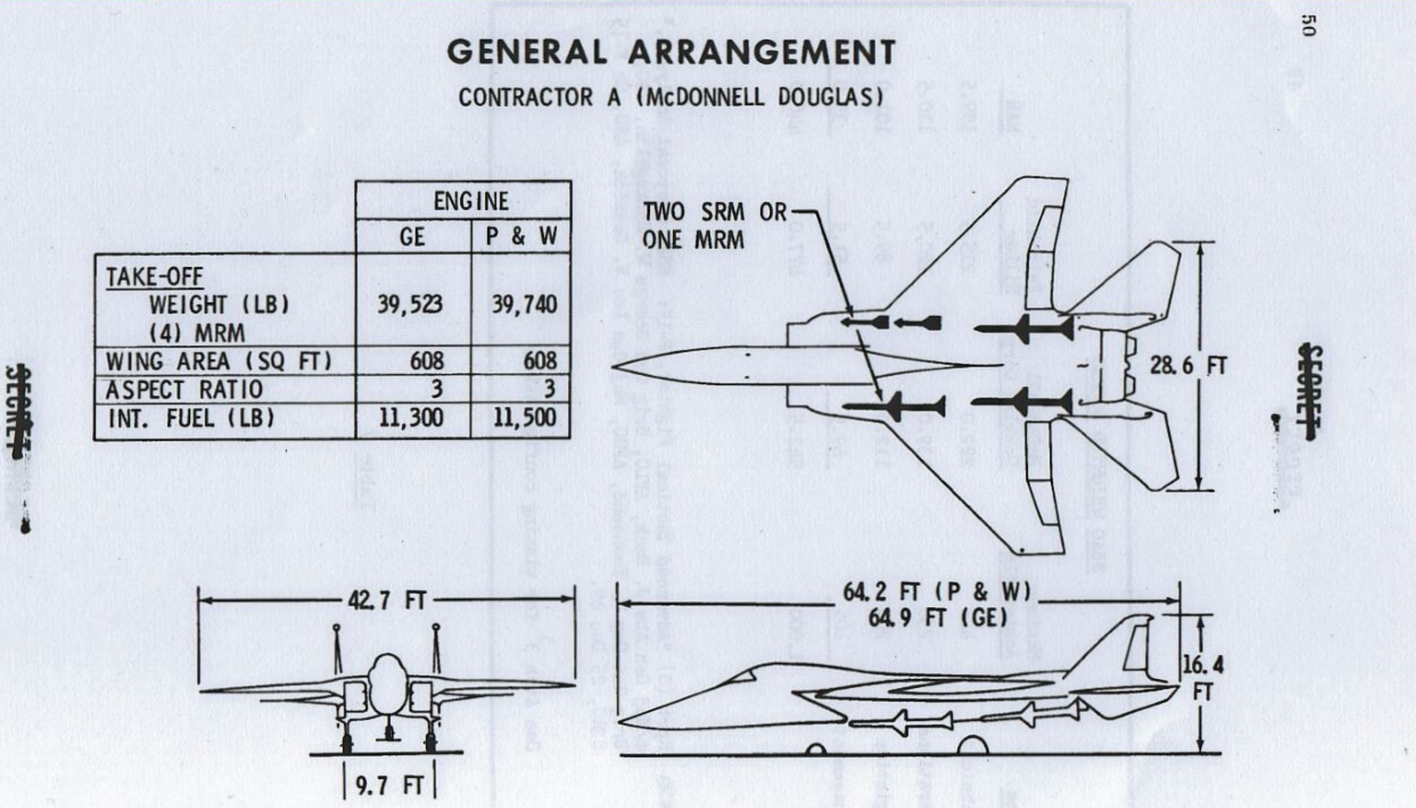


Diagram 1

handy air-combat dogfighters – history has since proven otherwise – especially after the defection by MiG-25 of Viktor Belenko, to Japan in 1976 – but it did add some impetus to the F-X programme. The original specifications for this were now being drawn up and – to act as a catch-all to any future MiG/Soviet design, it was decreed that the F-X would have a "25% superiority over the MiG-21".

F-X GATHERS PACE, ENTER THE 'MAFIA'...

At the end of 1965 the USAF sent RFPs (Requests for Proposals) to 13 aircraft manufacturers for the initial design studies, resulting in 500 differing designs. By now the F-X was a large aircraft in the 60,000lb (27,273kg) class, a top speed in the region of Mach 2.7-2.9 with many designs using the 'en-vogue' variable geometry design. It was around this time that a group known as 'The Fighter Mafia' got involved.

Also known as 'The Lightweight Fighter Mafia' the core members were: Colonel Everest Riccioni, Colonel John

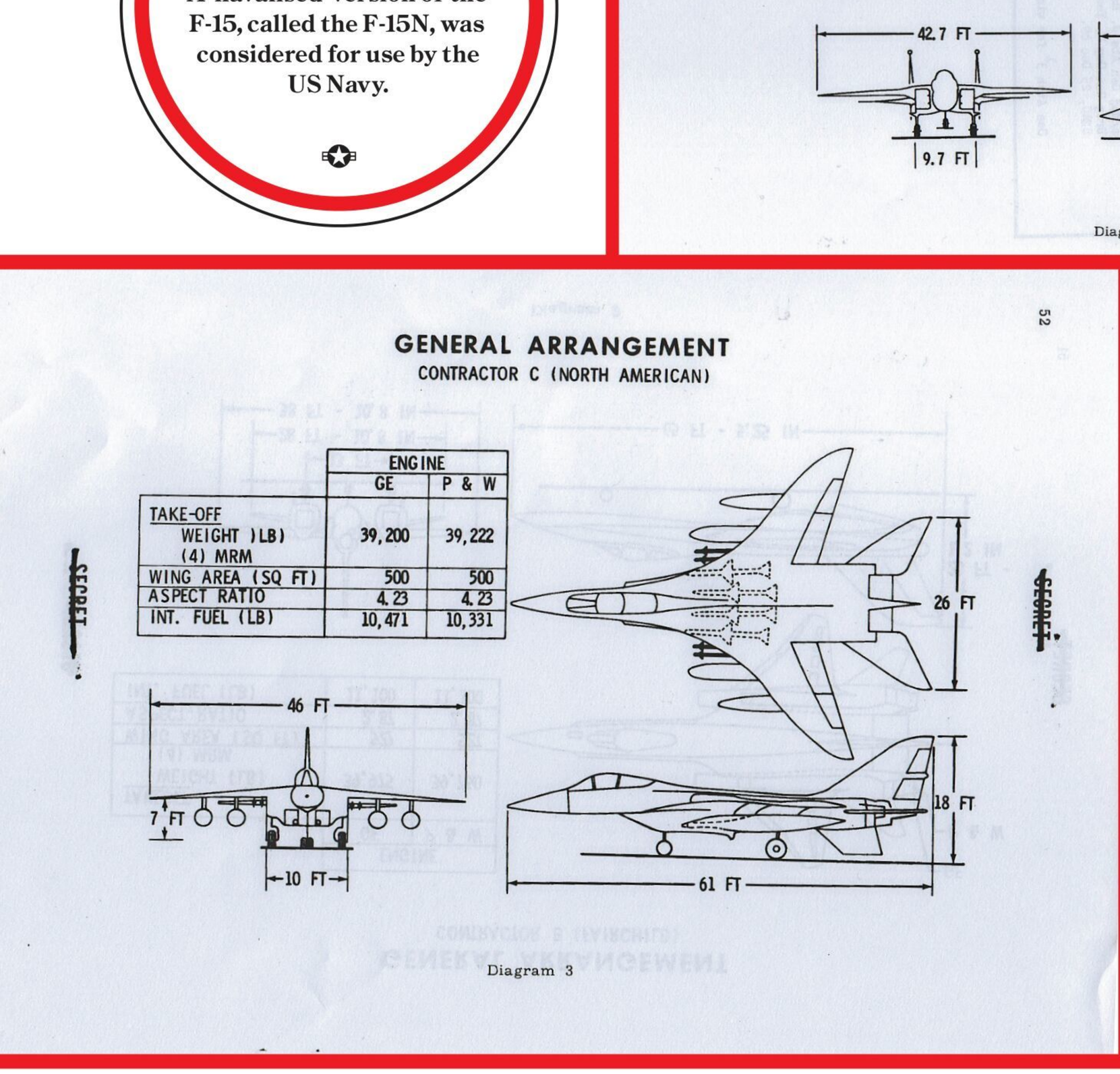


Diagram 3

Boyd and civilian analyst Pierre Sprey. Others are mentioned as also being 'in the family', including Deputy Defence Secretary David Packard and General Dynamics designer Harry Hillaker.

The F-X programme that led to the F-15 Eagle saw the original specifications increase in weight and sophistication, but many inside the Pentagon were vehemently against weight and sophistication. Sprey – a weapons systems analyst – argued for a simple machine in the 25,000lb (11,340kg) class, armed with a simple radar system, a gun and a pair of lightweight missiles, to help bolster the numbers in the USAF compared to procuring a large, complex and expensive F-X. This was initially looked on as being the F-5, then became the F-XX (or FX squared) proposal and then (ultimately) the LWF Light Weight Fighter, which finally resulted in both the General Dynamics F-16 Fighting Falcon and later the McDonnell Douglas F/A-18 Hornet.

Colonel John Boyd had a hand in both the F-16 and what would become the F-15. In October 1966 he was assigned to review the F-X studies. Boyd was a bit of a maverick. A time-served fighter pilot, he was an influential voice in the USAF's fighter community. Further still, Boyd linked up with Thomas Christie – a mathematician – to develop his quantitative theory for measuring the energy and agility of comparative fighter aircraft. Boyd was asked to overlay this theory on the specifications of the 60,000lb aircraft that the USAF was asking for.

Eventually, both Boyd and Sprey got involved with F-X and the weight of the proposed aircraft tumbled. By September 1968 there was a more refined set of specifications from the F-X SPO (Systems Program Office). They issued RFPs to eight manufacturers and just three had responded by the end of the year: Fairchild-Republic, McDonnell Douglas (merged together just the year before) and North American. All would receive more than $15 million each for the Contract Definition Phase.

By now the F-X was defined as a single-seat, fixed (not swing) wing aircraft, featuring twin-engines and being of around 40,000lb in weight (18,182kg). With both Boyd and Sprey angling for a more basic or austere F-X, they couldn't get the aircraft to be made any smaller but they could make it cheaper. Some of their thoughts led the F-X proposal to have reduced-cost avionics, ironically losing the TISEO system (Target Identification System, Electro-Optical) which later appeared as part of the F-15's FAST (Fuel and Sensor Tactical) packs system. The loss of this and some air-to-ground provisions lowered the unit cost of each F-X by around $1 million each. This – and other reductions instigated by Deputy Defence Secretary David Packard – meant that the entire programme stayed on or below the $1 billion limit, where the selection process could be more delicately scrutinised.

A foot-note on the 'Fighter Mafia' is that when Colonel Boyd saw one of the first mock-ups of the F-15, he looked up in astonishment and gasped: "Good grief, it's too big!"

MCDONNELL DOUGLAS WINS IT

So let's look at the three main designs for the F-X/F-15 proposal as it was now named.

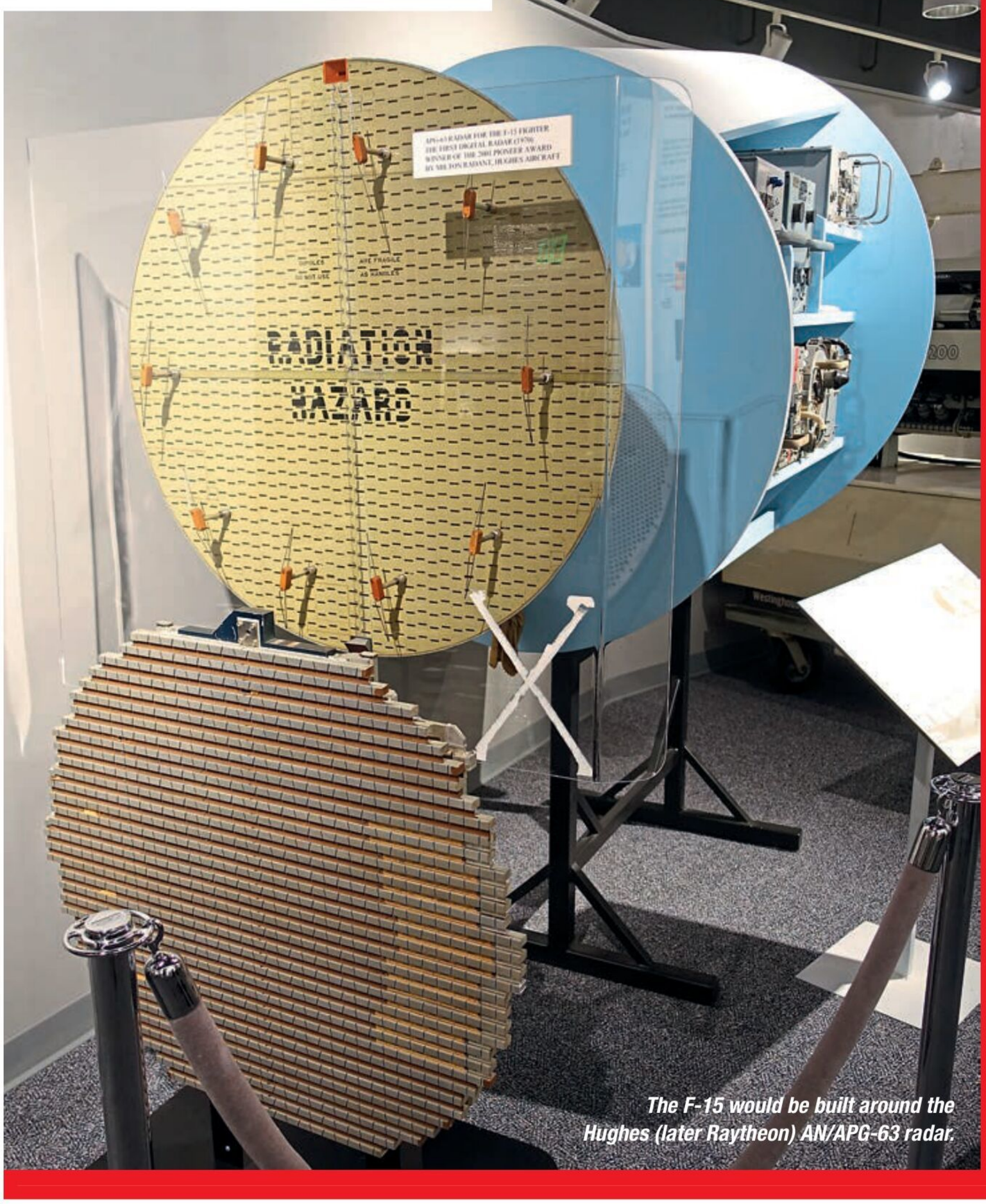
'Contractor C' was North American, with a 46ft wingspan and a 500sq ft wing area. Internal fuel was rated at around 10,400lb with a take-off weight with four medium-range air-to-air missiles at around 39,200lb. The general design featured centrally-buried engines, angled intakes and a single large fin (with dorsal fin) and a blown cockpit canopy.

'Contractor B' was Fairchild, with two, podded engines under each wing, a single vertical fin, bubble canopy and widely-spaced horizontal fins as a result of being attached to the engine trunks. Wing area was around 527sq ft and internal fuel 11,100lb. Take-off weight was around 39,800lb.

Finally it was 'Contractor A' from McDonnell Douglas. This proposal – called the 199-B – had two well-spaced engines (but not as widely spaced as the Fairchild offering) fed by two sharply-raked intakes, a bubble canopy but two vertical fins (originally the F-15 had a single fin, but this was changed late in the day) as well as two, small ventral fins below. Take-off weight with four medium-range missiles was around 39,650lb but with a substantial wing area of 608sq ft and 11,400lb of internal fuel.

This design benefitted from the work done on the previous F-4, a team then led by Herman Barkey. Under his command, the design work on the F-15 for McDonnell Douglas was led by George Graff, who was

"The F-X/F-15 proposals would increase and decrease in weight as time went on. However, when Col. John Boyd saw the first F-15 mock-up he would exclaim: 'It's too big!'"



The F-15 would be built around the Hughes (later Raytheon) AN/APG-63 radar.

ABOVE: ***The F-15 would be the second 'fighter' to use a head-up display after the Vought A-7 Corsair.***

BELOW LEFT & RIGHT: ***The HOTAS (Hands On Throttle and Stick) button layout on the control column and throttle quadrant was a refinement of an earlier idea seen on RAF BAC Lightnings.***

F-15 FACTS

The Eagle is the only aircraft to have ever 'shot down' a satellite!

appointed head of the design team. The deadline for the proposals was the end of June 1969 and McDonnell Douglas' proposal was a total of 37,000 pages that stood 11ft high! This was the end result of more than two and a half million man hours of work.

And it was a success as by December 23, 1969, McDonnell Douglas was announced as the winner. The resultant aircraft promised to be everything the F-4 was, and wasn't. In no way was the F-15 going to be a tactical strike-fighter with multirole capability (although this would be latent in the design itself as was later proved) however it was going to have the added benefit of being able to out-manoeuvre anything in the sky thanks to that large wing and two, powerful Pratt & Whitney F-100 engines. Lessons learned from Vietnam saw the inclusion of a 20mm Gatling gun in the starboard wing root, something that many USAF fighter pilots had asked for.

An interesting start to the project was that the F-15 came straight from the drawing board – there was no 'fly-off' against a rival airframe, as there often had been previously and was later. Much criticism from previous programmes (such as the F-111) meant that this way forward was to be employed: and it worked.

The McDonnell Douglas team had looked at variable geometry early on, but then rejected it down to excessive weight. Instead a 45-degree swept wing of large surface area was to be employed (following a study of 100 different designs and a year in the wind tunnel). Surprisingly that

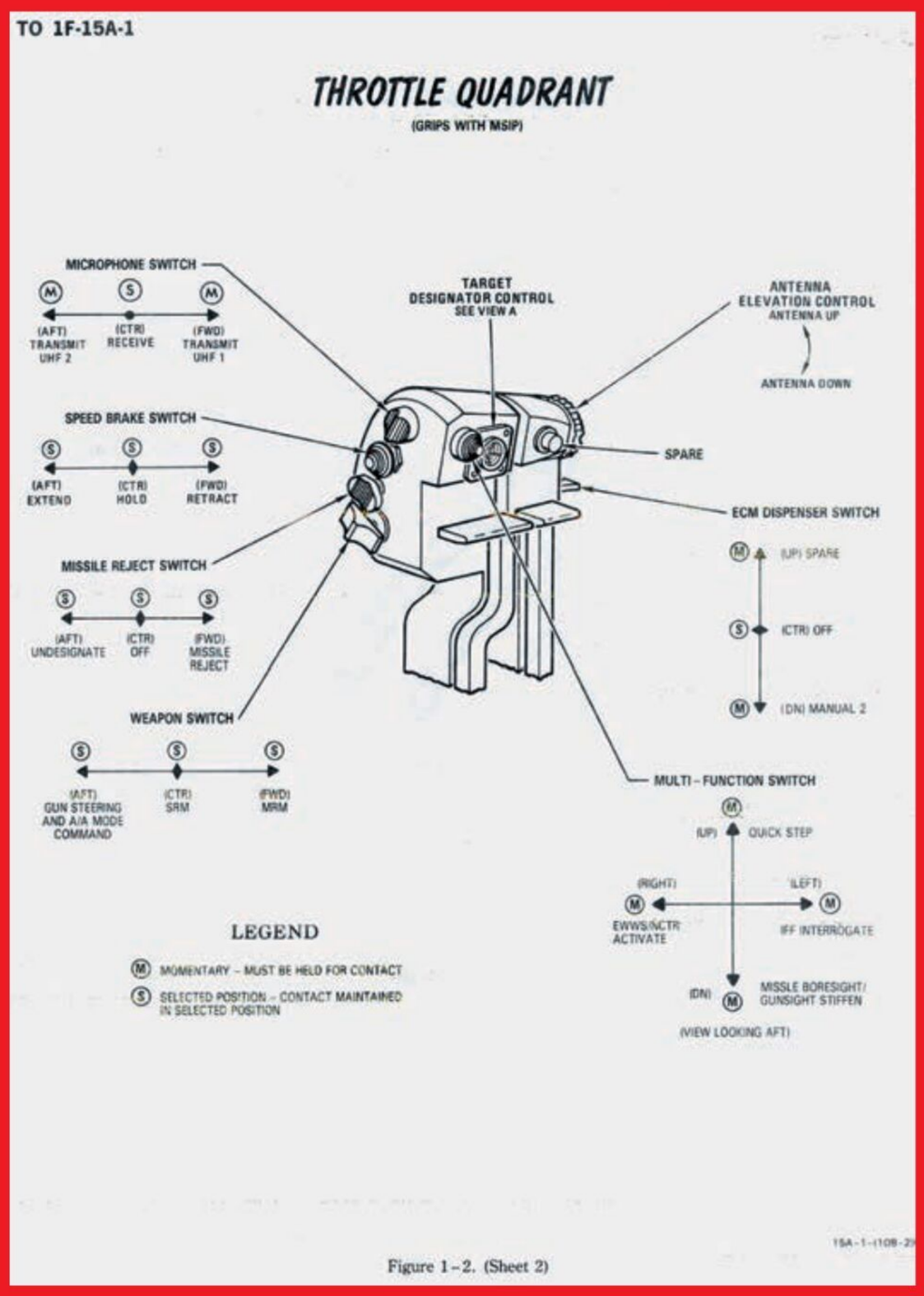


Figure 1–2. (Sheet 2)

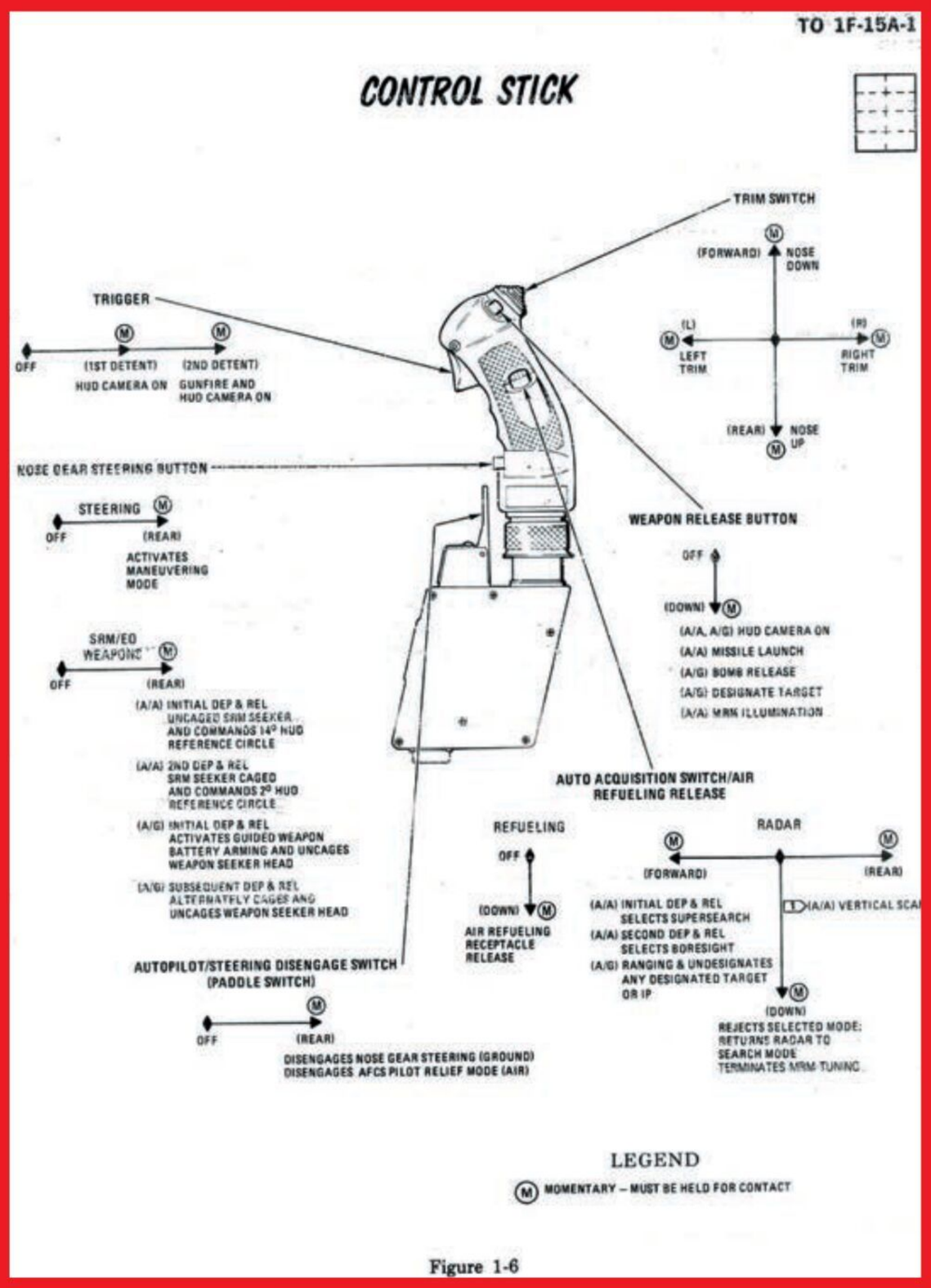


Figure 1-6

large wing featured no high-lift devices like those seen on the slatted wing versions of the company's previous aircraft – the F-4E and S models of Phantom. In fact, an 'Agile Eagle' – a modified YRF-4C had been testing slats destined for the Eagle. Instead it was found that the wing just didn't need them, being of a highly cambered design that was extremely efficient in most regimes. Light weight was a priority, hence titanium would make up almost 26% of the airframe compared to just 9% on the F-4.

The use of an advanced radar (the Hughes APG-63 pulse-doppler 'look-down-shoot-down' unit) allowed the F-15 to be single-seat, without the separate job of radar lock and radar management to be taken on by a back-seater or 'RIO' (Radar Intercept Officer). Hughes received an $82 million contract in September 1970 to build these units.

The radar was going to be a big jump forward in capability over that seen in previous F-4 Phantom II variants. The AN/APG-63 radar would be much more adaptable and powerful than the Westinghouse APQ-100/109A seen in the F-4C/D and AN/APQ-120 seen in the F-4E. While the APQs were low pulse repetition frequency radars, the APG-63 used high PRF and medium PRFs to locate and track targets even in ground clutter. The use of HPRF and MPRF also meant that the previous weak point of a pulse-doppler radar in a tail-chase, were addressed thanks to HPRF and MPRF interlocking to give a much clearer picture of the target. For ease of use, the AYK Central Computer was integrated with 13 on-board systems, including the Tactical Electronic Warfare Suite (TEWS) which meant that the computer was effectively taking over a number of the systems previously operated by the Weapons Systems Officer (WSO).

The result was a radar with almost four and a half times the search volume of the Phantom II and where the F-4 would have a 40 nautical mile search range on a fighter-sized target with a 10NM lock-up range, the AN/APG-63 gave the Eagle the eyes to detect bogeys at double that range in the 'look-up' mode or identical 40NM range in the more difficult 'look-down' mode.

Some of the systems used in the cockpit would also make things easier for the single pilot. For the first time in an out-and-out fighter, a wide Head-Up Display was used. First seen in the A-7 Corsair, this replaced the traditional 'gunsight' – instead giving vital information on the aircraft's speed, altitude and engine power as well as information for weapon deployment.

The use of a HUD would soon become de-rigueur for any strike/attack or pure fighter as would another innovation called 'HOTAS'. 'Hands On Throttle And Stick' is a system where the key controls are placed on the joystick and the throttle

"With survivability the key, the F-15's systems would be very advanced with a long 'reach' radar and a defensive ECM suite."

BELOW: ***A realistic simulator sped up development: this is a later cockpit layout.***

***RIGHT:** The F-15 would see not only a 'new' airframe developed, but also the Pratt & Whitney F-100 turbofan. This is the later Dash 229 version.*

controls so that the pilot does not have to delve down into the cockpit for a vital switch when flying the aircraft.

Linked with the HUD it allows the pilot to perform all the basic functions of air combat without removing his hands from stick or throttle or go 'heads down' in the cockpit. The idea was first used in the BAC Lightning, where some controls for the Ferranti AIRPASS radar/gunsight were placed on the hand controls but this system was refined still further for the F-15 and subsequent fighters.

With each different aircraft the buttons would do different things – for example the later F-15E Strike Eagle would be able to control any sensors such as the Forward Looking Infra-Red systems (FLIR). But, generally HOTAS-equipped fighters would have a 'coolie hat' atop the main joystick to help with trimming the aircraft, a trigger for weapons firing (normally cannon/air-to-air missiles) another weapons release button near the coolie hat for air-to-ground ordnance. Other buttons and levers would either engage or disengage the auto-pilot, open or shut

F-15 FACTS

The F-15 was used in the dramatic Israeli 'Operation Opera' alongside F-16s, where they destroyed an Iraqi nuclear reactor.

air-to-air refuelling doors and engage/disengage nose-wheel steering systems. On the throttle quadrant, comms/microphone switches, the airbrake, the moving/slewing of the radar antenna, weapons selection and electronic countermeasures could be controlled/ejected. To add yet more functions, switches could be held on, or 'rocked' to add more complexity. While the HUD/HOTAS combination was a great move forward for the fighter or attack pilot to keep his or her 'situational awareness' outside of the cockpit, one F-15C pilot remarked to the author that: "You soon get used to it in the simulator and in the plane itself so that you have the manual digit dexterity of a piccolo player!"

First-flight pilot Irving Burrows said in a 2003 interview: "As test pilots at McDD our staff had a small part to play in those early days – but we'd like to think an important one. We had assigned a team to work within the company, and with the customer when appropriate, to help make our version of the F-15 the best 'pilot's' airplane. Individual test pilots were assigned to areas including cockpit design. One of the products of this process was the development of the HOTAS system. We called this system 'Hands On Throttle And Stick' since the pertinent switches were all incorporated on the throttles and control stick. It was to become the model for cockpits in all subsequent fighter planes."

Armament was to be what went before but with a big difference – advanced versions of the AIM-7 Sparrow (which had proved to be such a disappointment in Vietnam) would be semi-recessed along the corners of the intake trunks, while four short-range infra-red guided air-to-air missiles – the ubiquitous AIM-9 Sidewinder – would be placed on inner wing pylons. The one big change from the early versions of the F-4 Phantom II would be the inclusion of an internal gun. The General Electric 20mm M61-A1 cannon had seen service since inclusion on the (ironically) poor dogfighter

> ***"The Eagle would be refined during its successful development and become a true 'pilot's aeroplane.'"***

LEFT & BELOW: ***Scale RPRV models of the F-15 were dropped from an NB-52 to examine certain aerodynamic characteristics.***

IRVING 'IRV' BURROWS

Burrows initially served in the United States Navy, began his flying career as a teenager and served in the Korean War.

In 1950 he was selected to begin training as a pilot in the USAF, graduating at the top of his class. Initially training to pilot the P-51 (by now called F-51) he was re-trained and flew the Lockheed F-80 Shooting Star and made reconnaissance flights in the North American RF-86 Sabre in Korea. He earned the Distinguished Flying Cross and two Air Medals after flying more than 100 combat missions. On leaving the Air Force he was employed at McDonnell Aircraft Company, joining the flight test department and attending the USAF Test Pilot School at Edwards Air Force Base in 1958 – the very year of the F-4 Phantom II's first flight.

Subsequently, Irv flew diverse McDonnell types including the F-4, F-101 Voodoo and F-3H Demon before his crowning glory – being selected as Project Pilot for the F-15 Eagle Programme.

Irv has many awards to his name, including the Ivan C Kincheloe trophy by the Society of Experimental Test Pilots as 'Test Pilot of the Year' for his work on F-15 programme (1974) he was made a fellow in the Society of Experimental Pilots in 1972 and served as its president in 1977. In 1989, the society presented him with the James H Doolittle Award while in 1984 he received the USAF Test Pilot School Distinguished Alumni Award in recognition of his work in flight test.

He retired from test flying in 1976 then held several positions at McDonnell eventually serving as executive vice president. Burrows continued to fly recreationally for a number of years after retiring from test flying and he retired from McDonnell in 1991.

BELOW: ***Irv Burrows; F-15 maiden flight test pilot.***

that was the Lockheed F-104 Starfighter.

Despite the initial decision to develop a newer more refined cannon, the Vulcan was eventually used on the fledgling Eagle. This 'gatling gun' was to be installed in the starboard wing leading edge together with 940 rounds of ammunition. Range was also to be important in this big fighter, so provision was made for the carrying of three 610-gallon drop tanks or up to 9000lb of air-to-ground stores: although the air-to-ground role was only secondary for the F-15 at this time.

PRATT & WHITNEY POWER

The engines that would power this fourth generation fighter would eventually become the safest ever used by the USAF. Like the Eagle itself, the F-100 can trace its roots back to the 1960s.

In 1967 there was a joint request from the Navy and Air Force for a new engine to power both the F-X (F-15) and the new Grumman F-14 Tomcat. While the USN (perhaps foolishly as it turned out) cancelled their requirement and continued to use the P&W TF-30 in the F-14, Pratt & Whitney won a lucrative contract to develop the F-100-PW-100 for use in the Eagle.

Like the TF-30, the F-100 would have its own early share of issues as it was developed for use in the F-15 and (in dash-200 form) for the F-16 Fighting Falcon. High wear was initially found, with some aircraft shedding blades. Poor afterburner light-up times were found too as well as another problem with the 'turkey feathers'.

On early F-15s (and later, the Rockwell B-1B Lancer's General Electric F-101 engine) it was found that the metallic plates that covered the intricate workings of the engine's nozzles, called 'turkey feathers', sometimes came off the aircraft during flight due to vibration issues. The easiest way to solve the problem was to simply remove the 'turkey feathers' which happened in the early 1980s. Over successive generations of the F-100 motor, all these issues were solved – hence later models of the F-15/16 powered by the 200/220/229 series of the family had their turkey feathers restored. Since then, the F-100 has become a byword for turbofan engine reliability.

MODEL MAGIC

Usefully for McDonnell Douglas, a three-eighths-scale 'Remotely Piloted Research Vehicle' would prove its worth in demonstrating the general design of the F-15 – but only 'after' the full-sized machine's first flight!

In November 1971, NASA approved flight research for the F-15 RPRV. It would measure 23.5ft in length and have a 16ft wing span and be recoverable in mid-air by helicopter. As a back-up to the long work done in the wind tunnel and on the full-size prototypes, this

***LEFT:** The first F-15 Eagle about to make its historic first flight.*

RPRV would feed data to the test team on basic handling as well as information on high AOA (angles of attack) agility of the F-15. These (relatively) cheap aircraft cost just $250,000 each, were made from fibre-glass and were unpowered. The project was backed up by a wealth of technology and facilities to get the most from the information garnered by these models.

Interestingly, these models were not to precede the flight of the main prototype, but instead increase the amount of data in a safe and controlled manner and carry a number of sensors and television cameras.

The first F-15 RPRV arrived at Dryden's Flight Research Center in December 1972 but didn't fly until October 12, 1973. The model was carried to an altitude of around 45,000ft beneath the wing of a modified NB-52 Stratofortress. Following release, ground pilot Einar Enevoldson guided the craft on a 10 minute flight which explored the McDonnell design's handling qualities, before being picked up by helicopter and lowered to the ground.

This helped development as it meant that during risky spin-testing the RPRV enabled the pilot to get a feel for how the basic F-15 airframe behaved, while not risking a $7 million full-sized aircraft. It made around 27 flights between 1973 and 1975 during early testing of the F-15 and explored many areas of the F-15's aerodynamic envelope, eventually carrying on until 1981 by which time 53 flights had been made.

ROLL-OUT, FIRST FLIGHT, FIRST GLITCH

To say that the F-X/F-15 programme was a 'big deal' for McDonnell Douglas was an understatement. The USAF was going to buy 749 F-15 Eagles, but before it became a fully-fledged production fighter, 12 F-15s would be used as Category 1 test planes, then, eight would be Cat 2 – later to be upgraded to operational aircraft, although this never happened.

The first F-15A prototype was built alongside the very F-4s it was designed to replace: F-4s that would see combat across the world. The Phantom II had become a global aviation phenomenon by the early 1970s and was the weapon of choice for the free world – more than 5000 would eventually be built. Would the fledgling F-15 garner as much success?

As the weeks and months rolled on, various 'firsts' were reached. Come February 1972 and the F-100 engine had completed 60 hours of testing, while the structural tests of the major sub-assemblies of the F-15 itself were completed some months ahead of schedule.

On June 26 roll-out showed this big new fighter to the world for the first (official) time and painted in air-superiority blue it looked the part. Burrows recalled: "This day in June I started up the engines and taxied out from our hiding place behind one of the hangars to a spot on our ramp in front of the crowd of company and USAF people and guests. A champagne bottle was swung very carefully by the wife of the assistant secretary of the Air Force and with the appropriate speeches the F-15 finally became the 'Eagle.'"

The aircraft was then dismantled and flown in a Lockheed C-5A Galaxy to Edwards Air Force Base in California ready for its first flight. The pilot of which – Colonel Jesse Jacobs – would later remind Burrows that it was he who was the first

F-15 FACTS

The use of model F-15s, dropped by a B-52, helped speed the aerodynamic development of the Eagle.

***RIGHT:** The Eagle's first flight was in a giant C-5 Galaxy transport...*

THE NEED FOR A GUN

The cannon was ruled out of the designs of the original McDonnell F-4 Phantom in the early-mid 1950s, when it was thought that a full air-to-air missile armament would be the future.

The air war over Vietnam, even by the early part of that conflict, had shown this was nonsense, even if the cannon-armed F-8 Crusader was taking down more bogies with Sidewinders than 20mm slugs from its four cannon.

For the USAF's F-4Cs and Ds, the only recourse was to use podded cannon – the SUU family – which replaced the centreline tank on the F-4C and D. The USAF began to use the SUU-16/A on the F-4s from May 1967 and the change it brought was almost instant. On May 14 – a day after an F-105 had destroyed a MiG-17 with cannonfire – aircrew from the 366th TFW destroyed three MiG-17s – two of them with the podded cannon and after initial missile shots had missed. The pods had proved their worth.

By 1967 the ultimate fighter incarnation of the venerable Phantom II was already on its way for the USAF in the shape of the F-4E, which had – beneath the radome – the same 20mm GE Vulcan cannon. Eventually in Vietnam, the F-4C and D models took down 10 MiGS with podded cannon, the F-4E shot down five enemy aircraft with the internal M61 while the F-105 took down three MiGs (one of which was shared with an F-4D) and even the B-52 bomber shot down two MiGs with its tail barbette of four 0.5in machine guns.

ABOVE: The cannon set-up in the F-4E went through many changes of muzzle design. This is an earlier version.

Other improvements came as a result of The Red Baron Reports and the Ault Report, where the lack of dogfighting skills/tactics in both USAF and US Navy doctrine was criticised – along with brochure performance rates of air-to-air missiles compared to actual combat conditions. This would lead to the formation of the Navy Fighter Weapons School, known more famously as TOPGUN and – thanks to Red Baron – the Red Flag series of exercises and the beginning of the Aggressor Squadrons, where experienced, highly-trained pilots in the art of dogfighting would aim to pass on hard-earned lessons to the pilots at squadron level.

Thanks to Vietnam the gun was back in fashion and it would be included on the F-15 Eagle. Initially it was to be a 25mm gun that would use caseless ammunition. A competition between Ford-Philco and General Electric saw the former company awarded a contract for what was called the GAU-7/A.

This was to be a revolutionary gun

The F-4E with Midas 4 gas diffuser.

ABOVE: The M-61 'Gatling' 20mm cannon was first used in SUU-16/23 pods on older F-4C/D and RAF Phantoms.

as – using telescoped ammo with a combustible casing – it was to have longer range, higher velocity (and therefore hitting power) and a flatter trajectory than the faithful old 20mm shell. Using a combustible casing means you don't have to have a system for ejecting the spent cartridges, or keeping them on the aircraft.

Sadly, by 1973 issues had been raised. The caseless ammunition would prove to be troublesome with some rounds exploding before being fired, meaning that the cannon fitment – on the F-15's starboard wing – and the ammo tank (stored in a vertical 'bin' arrangement below the dorsal air-brake) had to be reinforced and lined. More than $100 million had been spent on the GAU-7 without clearing these issues and it was in 1974 that the Eagle was to return to the tried-and-trusted fitment of the 20mm M61-A1 Vulcan cannon, that had seen service in the US since the introduction of the F-104 Starfighter back in 1956.

Since then, cannon have been an integral weapon on most fighter and attack aircraft including the latest F-35 Lightning II and have proven their worth in air-to-ground missions in Iraq and Afghanistan – even if the last air-to-air guns kill was recorded in 1988.

BELOW: The F-15 Eagle would have the Vulcan cannon buried in its right wing root.

man to actually get an F-15 airborne.

Irrespective of the F-15's first flight in the hold of a C-5A, many McDonnell Douglas pilots had 'flown' the Eagle in the simulator. This was – for the late 1960s/early 1970s – pretty new tech. Irv Burrows said: "One of the tools we used extensively was the simulator. This was a cockpit built to scale with as much realism and accuracy in it as possible, but it was stationary inside a building. The instruments inside provided feedback to the pilot who was 'flying' the simulator: typically the cockpit was inside a large dome, on the walls of which could be projected clouds, the ground and even another airplane.

"The pilot could then fly the simulator in any number of tasks, from take-offs and landings to dogfights with other aircraft (flown by a computer or another pilot). Back in those days our simulator facility was on the cutting edge of technology. We test pilots spent a lot of time over there as did some of our USAF counterparts."

The use of the simulator didn't just give the test pilots the 'feel' of the real Eagle and how it might perform it also helped develop systems, switches, cockpit layouts and the like for the production aircraft to come.

The aircraft that was to be the first Eagle in the air was serial number 71-280 and it was the culmination of many years of work but it was still – effectively – the 199-B which won the contract back in 1969. Refinements were few, but gone were the ventral fins and in came larger main vertical fins. NASA (which worked with the USAF during selection as well as independently evaluating the designs) noted that subsonic drag was higher than originally thought, so the design change removed the ventral fins and subsequently added the needed area above.

> ***"For the first flight, Edwards was chosen, adjacent to the large, dry 10-mile lake bed of Muroc - just in case things went wrong."***

By the time of the scheduled first flight – July 27 – the Eagle had gained day-glo wing tips, tails and intake trunks and a pitot/test boom on the nose. In a 2003 article first flight pilot Irv Burrows talks about the run-up to that fateful day: "Joe Dobronski, my boss and chief test pilot assigned me as first-flight pilot: a wonderful opportunity for me," explained Burrows. "There isn't a test pilot in the business who would not jump at the chance to make the first flight in a newly-developed airplane. My good friend Pete Garrison would be back-up pilot in case I broke my leg skiing or some such thing!"

ABOVE: ***Irv Burrows (centre) and crew before the first flight. Despite glitches, all went well.***

For Irv, thoughts were already on him flying a new airframe and new engines, as – by that point in time – it was hoped that the F-100 would have been flying in the F-14 Tomcat, if only the Navy hadn't pulled out of the joint engine programme… Burrows remarked: "So, we'd be flying a brand-new airplane with engines that had never been developed through airborne testing. That's why we made the first flight at Edwards, just adjacent to the dry lake, Muroc Lake, which provided us with a ten-mile long emergency runway – should we need it."

With much of his huge experience on the F-4 Phantom over the previous decade, on the run-up to the first flight Irv managed to get (with USAF approval) a number of flights on other aircraft, such as the F-104 Starfighter, the Northrop T-38 Talon, as well as McDD's own A-4 Skyhawk: "Pete and I did this as we believed we needed to expand our horizons a bit and prepare for a new and different cockpit and airplane feel." More time in the simulator would copy exactly the first-flight profile.

At around 7am on the morning of July 27, 1972, Burrows climbed into 71-280 after a long, detailed walk around the aircraft,

before which the twin F-100 engines had been spooled-up, with the aircraft restrained and chained to the ground. Helping him strap in was Glenn Lewellyn, an inspector on the project. Most of the team from McDonnell Douglas were based about 40 minutes away and they had left at around 4am to get the F-15 ready for this historic moment. Burrows would be 'chased' by his good friends Pete Garrison and Colonel Wendell 'Wendy' Shawler – who would later be the first USAF pilot to fly the Eagle and the first-flight pilot of the A-10B Night/Adverse Weather Thunderbolt II two-seater. Both flew in F-4 Phantoms with a cameraman in the rear seat.

Burrows placed 71-280 at the end of the Edwards runway and unleashed the power of the F-100s with his left hand. This was maximum 'dry' thrust without afterburners, so this meant the pilot would get a good feel about the aircraft on take-off and learn something about its behaviour. The aircraft then jumped into the air for its first 50 minute (or so) flight. During which time the Eagle got to 12,000ft and a max speed of 320 miles an hour.

But it wasn't without incident. Burrows: "So off we went – a comfortable take-off and impressive performance to around 2500ft. Then came the only glitch in the first flight. When I retracted the landing gear a red light in the cockpit told me that all was not right. Either Pete or Wendy moved in close enough to see that one of the doors that closed over the gear when retracted was not closed flush. Enter plan B: after extending the landing gear (and heaving a sigh of relief that all three wheels were going to be in the right place for landing) we proceeded with the back-up plan – a test flight with the wheels down.

"Over the next hour or so we were able to accomplish a lot – handling quality checks on both the airplane and engines up to 15,000ft or so, speed brake extensions (during which we experienced too much buffet) practice landing approaches to get a feel for a good approach speed and afterburner light-ups and shut-downs on each engine. We were able to compare the airplane's flying qualities with that of the simulator and found that the correlation was quite good. The airplane 'felt good' the visibility from the cockpit was spectacular, the response to control movement was quick and precise and the power from the engines was impressive. Bob Little, who as chief test pilot for McDonnell back in 1958 had made the first flight on the F-4 Phantom II, once told me: 'I knew it was a winner.' I felt the same about the Eagle."

Burrows made the landing approach at around 170mph, made a gentle touchdown with the dorsal airbrake only half extended. He held the nose-wheel up until the Eagle was going quite slowly before letting it kiss the ground. All three wheels were down and the first flight had been a success. After touchdown the canopy cracked open and Irv got out: giving a 'thumbs up' sign to the waiting McDD crew and staff. For the Eagle, it was an auspicious beginning and the test schedule was going to be a busy one.

The flight test programme continued on schedule without any major issues through to the F-15's 1000th flight in November 1973, by which time the Eagle had really spread her wings, flying at over 60,000ft and reaching a top speed of Mach 2.3.

The Eagle had finally flown the nest.

F-15 FACTS

The Eagle was designed to have a maximum speed of around Mach 2.5 or around 2000mph at altitude.

First flight issues meant that the landing gear had to stay extended for the duration of the flight.

INTO SERVICE

Developing a top-line military jet fighter is never going to be without its issues, but the F-15 Eagle enjoyed a relatively smooth ride into service with the USAF at the height of the Cold War.

The colourful 'bicentennial bird', the TF-15 would showcase the brilliance of the F-15 design on a big European tour where the aircraft performed 92 demo flights in just 43 days.

CHAPTER 3 – INTO SERVICE

> *"Hours in the wind-tunnel, the simulator and NASA-input would mean the F-15 would have an ease-of service entry not seen before in the jet era."*

Following the first flight of the prototype, the development flights for the test programme got under way.

For such an advanced aircraft, things went remarkably well, with many attesting that the hours in the wind tunnel and on the simulator had paid real dividends. As an example, within four months of flight testing the engine inlet compatibility was completed for the F-15 programme. For the F-4 this alone had taken 22 months, while in the F-101 Voodoo it had taken 30 months.

While pilot feedback on the Eagle was initially very positive, there were some issues to be ironed out. Pilots found that on cross-wind landings one of the wings wanted to lift up on the down-wind leg. This was solved with changes to the control augmentation system. While the F-15 was flown with conventional hydraulic controls without the use of a fly-by-wire system in the later F-16, the CAS was basically a computer between the pilot and the controls which helped the pilot avoid dangerous parts of the performance envelope, effectively making it safer to fly. A number of issues were solved by simply changing the CAS.

ABOVE: ***Pre-production test F-15 airframes share the ramp with F-4 test machines.***

By the end of 1974 only 36 engineering change proposals had been submitted and only three affected the overall 'look' or aerodynamic shape of the F-15 itself. The first was the rear, twin horizontal tail units. It seemed that there was a buffet issue but a dog-tooth leading edge cured the problem. The second was the main wings. At speeds of around Mach 0.8-0.95, at altitude and pulling around 6g there was a serious buffeting which pilots described as severe: so severe some felt the aircraft was going to break up in flight. This was found to be caused by the rear part of the wing-tip getting excessive lift. To cure this, the wing-tips were raked back and 3sq ft was removed from each wingtip. Finally, the buffeting that Irv Burrows described from the dorsal airbrake on that first flight was solved when they upped the size of it from 20 to 31.5sq ft, so more drag was produced at less than full openings.

These changes were subtle and hard to spot, but taken together they show the way F-15 development was going: fast. Production was also speeding up, with the first five aircraft taking just 466,000 man hours to produce compared to the

F-15 FACTS

The Eagle took 20% fewer hours to build than its predecessor the F-4 Phantom!

690,000 expected. By the spring of 1974 it was estimated that the F-15 Eagle took 32% fewer man hours to build than originally thought. Six performance milestones were set for McDonnell Douglas to complete by the end of 1974, but by April 1973 McDD had already completed four of them.

It wasn't all sweetness and light: firstly there were cost overruns, which by the late 1970s amounted to several billion dollars over the initial costings. Second, the Pratt & Whitney F-100 engines were having their own problems, including afterburner light-up issues (thanks to pressure build-up in the engine nozzles), fuel control problems and some turbine blade issues.

Early on – and when the F-16 had come on stream with its single F-100 powerplant – it was said that the F-100 in the Eagle took double the man-hours of maintenance effort than on the Fighting Falcon. Some put that down to airflow around the engine: no F-16 ever had its 'turkey feathers' the petals in the afterburner removed.

Another big 'first' for an engine was the amount of times the thing would go from full military power or even afterburner back down to idle. With the F-15 effectively heralding in a new era of dogfighting, not just the airframe but the engines were regularly being put through their paces and not just left in full power, but going from idle to full AB during dogfighting. History shows that the engine has gone on to be a paragon of safety, performance and excellence, but issues and cost implications are what's going to happen when you're developing not just a new airframe, but the powerplant and avionics as well.

***ABOVE:** The F-15 used fewer man hours to build and maintain than the old F-4 Phantom.*

It was a unique situation and one that was handled brilliantly by all concerned, even if – during 1978/79 – there was the situation where Eagle airframes were coming off the line without the engines to put in them.

With such advanced avionics, again it was a considerable achievement that so few issues raised their heads. The advancement that helped was that the use of 99 LRUs (Line Replaceable Units, effectively black boxes) and a system with BIT (Built-in Test) meant that – yes there were a considerable number of issues which often led to maintenance being behind the 8-ball when it came to repair, even leading to the odd bottleneck, but lessons were learned and improvements were made swiftly.

The more pilots who flew the F-15 the more came to love its virtues of power, agility and (especially) sustained turn – as well as unrivalled (until the seamless F-16 canopy) visibility from the pilot's seat. The differences between the Eagle and its predecessor the F-4 (still, by 1974, in full production for the USAF and overseas customers) was huge and not just in terms of outright performance: that was a given.

By early 1974 it was found that building an F-15 took only 80% of the man hours it took to build an F-4. This was thanks in part to large machined components which meant fewer joints. Many other systems were reduced or rationalised. The F-15A didn't need a landing parachute – unlike the F-4E. It had 30 cockpit instruments compared to the F-4's 48 and nine flight control 'black boxes' compared to the F-4's 16. The F-15 had around a third of the plumbing connections the Phantom had, 1200 to 2800 fasteners and a hundred fewer electrical connections. It also had four times the area of quick-release hatches for maintenance compared to the F-4. Best of all, the F-15 was working out to be 11.3 maintenance hours per flight, compared to 24 for the F-4E – that was in Second World War fighter territory.

TWO-SEATER ROADSHOW, FIRSTS AND SERVICE ENTRY

With development continuing apace, it was decided in 1974 to push the F-15 Eagle to the outside world. To this end, the second F-15B (still known then as the TF-15) was to display at Farnborough. First flight pilot Irv Burrows was joined by Colonel Wendell Shawler to fly to the UK and demonstrate the F-15 to the world.

The flight went from Loring Air Force Base in Maine and flew straight to RAF Bentwaters in the UK in just under five and a half hours. The F-15B was carrying drop tanks as well as the then-new FAST 'Fuel And Sensor Tactical' packs scabbed under the inside of each wing and attached to the intake trunk side. This extra 10,000lb of fuel effectively doubled the aircraft's ferry range.

During a European tour, the aircraft performed 92 demo flights in just 43 days. Over the next few years, the F-15B would showcase the power and agility of the Eagle with flights – not just in the UK – but in West Germany, Japan, South Korea, The Philippines, Denmark, Iran, Norway, the Netherlands, Israel, Belgium, Saudi Arabia, Australia, Guam and Canada. It was clear that many of the stop-overs were in countries that might be in the market for a modern fighter jet…

With the Eagle approaching service entry, it was important to get the right guys (and they were all guys back then) into the cockpit of the USAF's premier fighter. The first rule was that any selected pilot would have 250 hours on fighters.

"The Eagle soon joined front-line USAF squadrons in service and ushered in a new era of speed, agility and all-round fighter capability."

It was logical that F-4E jocks would be the prime candidates to slip into the F-15 cockpit, but the USAF found that adaptability and the individual's ability to learn was of prime importance.

Eventually, in January 1976 the 1st Tactical Fighter Wing – with tail-codes 'FF' based at Langley, Virginia began to convert to the new McDonnell-Douglas fighter and this is where many of those early problems were encountered – and ironed out. The second wing to equip was the 36th TFW, based at Bitburg in West Germany, proudly using the 'BT' tail code. This wing became operational a year later, in 1977, by which time the third wing was gearing-up for conversion: the 49th TFW at Holloman Air Force Base, New Mexico.

The first Eagle deployment to Red Flag at Nellis Air Force Base was made in 1976. This helped accelerate operational

ABOVE: The Streak Eagle was a stripped-down early F-15A built for outright speed and climb.

STREAK EAGLE

Much was initially made of the F-15 Eagle's amazing speed and – indeed – thanks to the threat of the MiG-25 Foxbat its dash speed of Mach 2.5 was much trumpeted in the early 1970s. This was, however, a bit of an irrelevance as with a decent warload the F-15 couldn't go much faster than Mach 1.7.

However, both the USAF and McDonnell Douglas knew that the speed of a fighter could be headline news. In late 1974 they got together to come up with an idea for an event to show the world this new fighter and show the US taxpayer what they were getting for their dollar.

Therefore – at an expense of more than $2 million – a 'show' was put on, where a stripped and lightened early F-15 would take a series of time-to-height records. Five of these records were held by the F-15's predecessor, the F-4 Phantom II from 1962 while the higher-altitude ones were held by the Soviets with their Foxbat.

Three USAF pilots were to take part in these attempts and they would break all eight records over a period of 17 days, between January 16 and February 1, 1975, over Grand Forks Air Force Base, North Dakota.

But first – what was 'Streak Eagle'? It was the 19th pre-production F-15 called 'F-17' and was stripped of all non-essential materials and equipment. All the radar and associated avionics, the Vulcan cannon and ammunition 'bin' and feed chutes, flap and speed brake actuators, radios, one hydraulic system, some cockpit displays

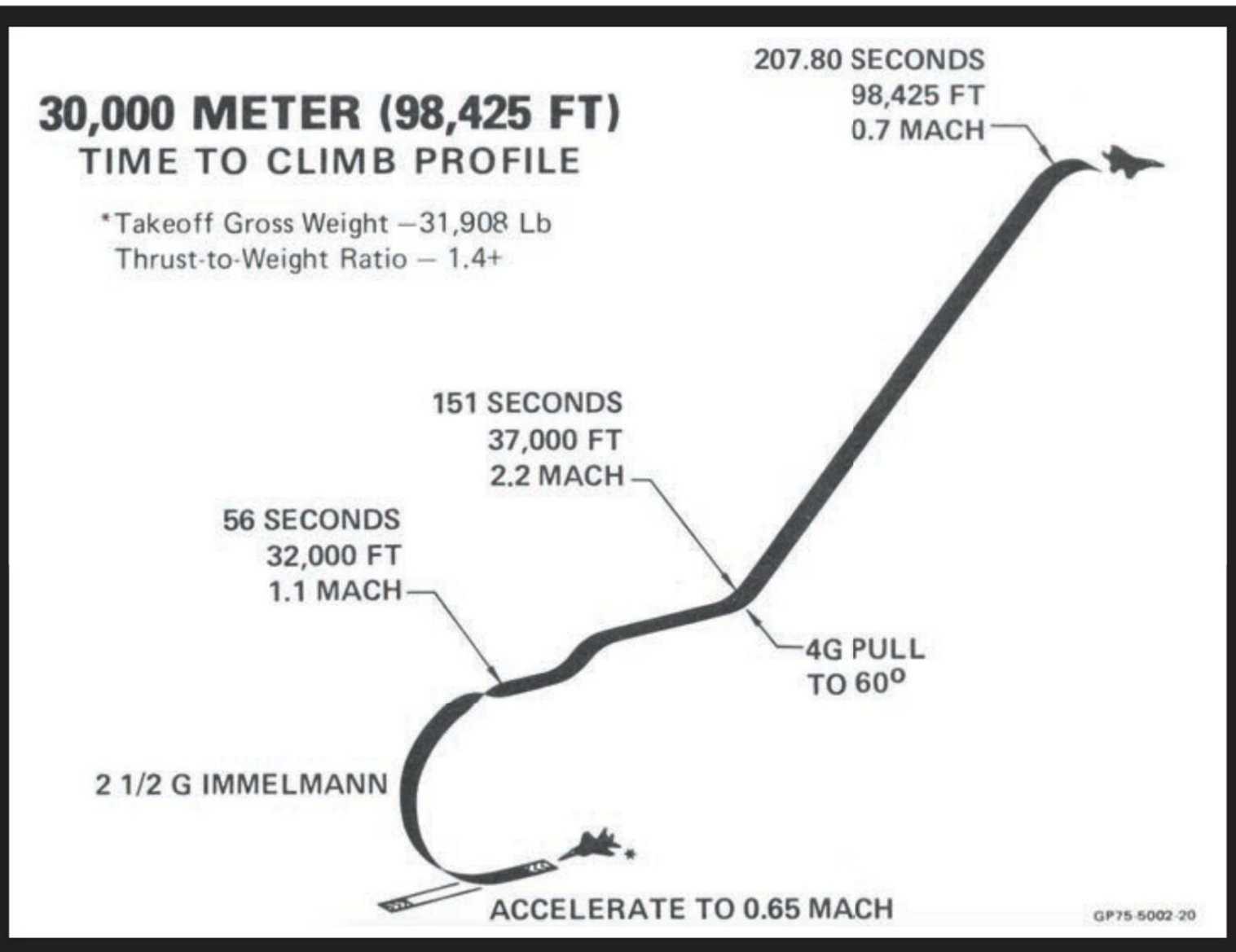
ABOVE: F-15 Streak Eagle pilots from left: Major WR Macfarlane, Major Roger Smith and Major Dave Peterson.

and a generator were removed. Some equipment was added, such as a pressure suit for the pilot on some of the attempts, a pitot boom to give more information to the pilot and instruments to help measure the speed and acceleration of the aircraft.

With all attempts beginning with a 'standing start', the arrestor hook was replaced with a hold-down hook which would be released when the timer was begun. Also, the entire surface of the aircraft was left unpainted, to save yet more weight (and gain around 15mph). The changes meant that Streak Eagle was 1800lb or 817kg lighter than a production F-15A and – to ensure the best performance – only the correct amount of fuel for the attempt would fill the Eagle's tanks. It was estimated that the Streak Eagle had a thrust-to-weight ratio of around 1.5:1!

***ABOVE:** These 22nd TFS (36th TFW) F-15As are seen at Alconbury in November 1978.*

***ABOVE:** The AIM-7 Sparrow and AIM-9 Sidewinder combination were the Eagle's early air-to-air missiles. Advanced AIM-9s and the later 'fire-and-forget' AMRAAMs would come later.*



ABOVE: A diagram of the 30,000 metre profile attempt.

On January 16 the five F-4-held records were broken all in one day. The first record to go was 'Time to 3000m (9843ft)' which Major Roger Smith beat by a 20% margin. The previous best was 34.52 seconds with the Streak Eagle setting a time of 27.57 seconds. The aircraft was taken to full throttle under the hold-back system and the Streak Eagle – when released – took off after only a 400m take off roll. So fast was the acceleration that the pilot had to be quick to get the undercarriage tucked away before the associated gear and doors went past their 'never-exceed-speed' as the aircraft went almost vertically upwards in a 5G climb. Some attempts were actually aborted due to this issue.

The next three records were beaten in a single flight, with times being taken at the requisite altitudes. In the 'Time to 6000m (19,685ft)' attempt Major Willard 'Mac' Macfarlane beat the F-4's time by 19% (48.79s vs 39.33s.) The 'Time to 9000m (29,528ft)' saw the F-4's 61.68s record beaten by 21% with the Streak Eagle getting to the required altitude in just 48.86s. For the 12,000m (39,370ft) attempt, the Eagle beat the F-4's best by 23%: 77.14s compared to the Eagle's 59.38s.

The last of the three flights that day saw Major Dave Peterson beat the old 'Time to 15,000m (49,212ft)' record by 33%: the F-4 could manage the height in 114.50 seconds but was thrashed by the Eagle's 77.02s time. For this attempt and all the later flights, pilots would be wearing a full pressure suit. And he'd need it… as Peterson lifted to around 50ft over the runway, at around Mach 0.65 he pulled hard on the F-15's control column and hit the target altitude some 10 seconds quicker than the time to that height set by the Saturn V moon rocket!

Now it was time to beat the Soviet MiG-25 Foxbat's 1973 records… On January 19, Smith would shatter the 'Time to 20,000m (65,617ft)' by some 28%, with the MiG-25 clocking 169.80 seconds and the Eagle 122.94. The Streak Eagle would start 'on the deck' at around Mach 0.65, before pulling up at just 2.5G into an Immelmann over the top at 32,000ft before accelerating in the opposite direction to take off, then pulling a 4G, 55-degree climb, supersonic, until it went through the requisite altitude. The same technique would be used on these higher altitude record flights.

On January 26, Peterson would take the 25,000m (82,021ft) record from the Soviet aircraft, beating it by some 16%: 192.60s versus the Eagle's 161.02. Smith would be back in the saddle for the 30,000m (98,425ft) record on February 1, where the Streak Eagle's winning advantage would be 15%, thanks to their 207.80s 'to-height' time compared to the MiG's 243.86s.

These records would prove to be a significant PR coup for both the USAF and McDonnell Douglas. So successful were the records set that they wouldn't fall until the 1980s, when – between 1986 and 1988 – a similarly stripped Sukhoi SU-27/T-10 (or P-42 as it was known) bettered the records, apparently boasting an almost 2:1 thrust-to-weight ratio!

The Streak Eagle itself – being a pre-production aircraft and one stripped of all non-essential equipment – was never made into a production F-15A (that was considered too costly) so instead it was painted in air-superiority grey – to prevent corrosion – and then delivered to the National Museum of the United States Air Force at Wright-Patterson Air Force Base, Ohio, in December 1980.

FLYING THE EAGLE

ABOVE: Don Kilgus cut his teeth in Vietnam in the F-100 and should be credited with a MiG-17 kill…

RIGHT: Don returns from a posting to be met by son Kevin.

What was the F-15 Eagle like to fly in the first decade or so of its life, when it was the new kid on the block? Donald W Kilgus flew the F-15 after a stellar and much decorated USAF career flying other combat aircraft.

Born on June 10, 1937, in Detroit, Michigan, Don was commissioned in the USAF in 1960 and initially flew the North American Super Sabre in Japan, in the USA and later in South Vietnam.

As a prelude to his time in the F-15, it's worth noting that he could well have scored the first MiG kill of the Vietnam conflict. The history books show this was made on April 9, 1965, by an F-4B Phantom II of the US Navy, but there's evidence (much from the Vietnamese themselves) to say that Kilgus actually took down the first MiG (a 17 'Fresco') on April 4 in his F-100D Super Sabre but it seems that politics at such an early stage of that conflict and the lack of initial confirmation meant that his kill wasn't officially recognised.

That story is beyond the scope of this book (although it's a great read, go look it up) but Don painted a MiG kill marking beneath his cockpit from then on. The man himself was to become one of a special breed of aviators, maybe unique as he was not only a MiG killer, but he would become a 'Misty' Forward Air Controller in his F-100 and become one of the early exponents of the art of the 'Wild Weasel', using the Republic F-105F and G Thunderchief, where his mission was to locate and destroy enemy radar and surface-to-air missiles. A dangerous job… Kilgus was forced to eject from his own F-105 in November 1970, after being hit by a SAM. He was later rescued by a Sea Stallion helicopter.

Fast forward to the mid-1970s and Lt Col Kilgus flew as an F-4 Phantom II and F-15 Eagle pilot, becoming commander of the 8th Tactical Fighter Squadron at Holloman from December 1977 to January 1980. Initially flying the venerable F-4E Phantom II, he was in charge of the unit when – in 1978 – they transferred to the F-15A Eagle. He retired from the USAF in 1985 as a colonel and tragically died in a car accident in July 1988, aged just 51. He won two Silver Stars, one for consistently exposing his aircraft and himself to enemy fire during a mission in which he provided cover to slower SANDY rescue air elements.

The following first-person account of flying and fighting with the Eagle was made after the early days of the F-15A and C into the mid-1980s and comes off the back of Don's many hours in other fighters as well as the 350 he logged in the Eagle and is reproduced here courtesy of the Kilgus family, following its appearance in *Take Off* magazine.

The F-15 is the first of a whole new generation of airplanes that can defeat the man flying it. You can pull so many Gs in this airplane, for so long, that it can out-turn you, physically. A man just can't sustain the G-loading."

Earlier planes – like the F-4E – would run out of energy before the pilot had to give in. You could throw it in to a 7G turn, but it couldn't sustain it for long. You're bleeding off the airspeed because you don't have enough power to keep it up above the point where you start losing energy. But in the F-15, even if you do ask it to do too much, where another aircraft would depart at high angles of attack the Eagle just gets tired. When you pull too hard or the airspeed gets too slow, it doesn't snap, it doesn't stall, it just tells you that it's giving you all it has – but that's rare.

I've been in fights with the Eagle where I've just pulled so many Gs for such a long period that I just had to physically let up on the pole so that I could get some oxygen back down into my lungs again. You can black out through G-LOC if you keep pulling – G-induced Loss Of Consciousness. That's why you have to recognise when that's coming. If you build up the G smoothly then you can tell when it's coming, when you start to black out as your eyes lose the blood-flow and oxygen going to them. But if you suddenly jerk into a 7 or 8G turn – and you can do that – then you can easily over-G your body and go into G-LOC.

That's why we have 'Bitchin' Betty to whisper in our ear and warn us that we're going into overload. Both the Phantom and the Eagle have an analogue flight control system called CAS – the Control Augmentation System. It's like a power steering set-up in a car. In the F-4 you could over-G it, but you knew you could, it took effort to do it! The F-15 is different: you know you can over-G it easily so the Overload Warning System gives you a warning – and nothing as basic as a hooter. We call the OWS 'Bitchin' Betty' as it's a female voice (tests show we listen to a female voice in times of stress) and in your headset she says: 'OVERLOAD, OVERLOAD.'

"If I had to go up against a MiG-29 and fight I would have complete confidence in the F-15. With that tremendous power behind you, you can choose the moment and altitude of your engagement, get on top of the other guy and really come boring down on him.

On guns and heat-seeking missiles you can concentrate on the visual engagement. The other guy appears in your HUD and you're looking at him, heads-up all the time. The F-15 can engage with the gun, Sparrows or Sidewinders, so we have a versatility we were lacking before. We're talking about a serious weapons load – internal M61-A1 20mm Gatling gun with 970 rounds (the F-4E only had 640) four AIM-7 Sparrows and four AIM-9 Sidewinders. It's no wonder that the F-15 is the world's best combat aircraft!

Set it against its predecessor, the Phantom and you can see the improvement in aircraft design: especially in radar.

ABOVE: The F-15 cockpit would evolve over time, but the original A/C model was fairly standard for a 1960s-derived fighter: apart from the HUD and HOTAS controls.

The F-4E's radar was never very good and it used to break down at the worst times. It cost a lot of guys' kills. To get good results out of the Phantom's radar you had to be very good.

As you fly more aircraft you realise what you'd do better or what you'd want done differently – and then along comes the F-15 Eagle and it's beautiful. It's got a cockpit as big and comfortable as the F-105 Thud, but better organised and better laid out. The most comfortable office you'd ever want to be in. Behind the seat there's even room for an overnight bag.

What's more important is the way the controls are laid out, the amount of thought that went into the design. HOTAS means 'Hands On Throttle And Stick and that means you don't have to move off your hands off the flight controls in order to do something else. All the controls you want are either on the throttle or stick. I control all the weapons like a musician plays his instrument: he doesn't look at his fingers and neither do I…

On the throttle lever there are 13 different controls. The speed brake, the mike buttons, a three-position switch that selects what you're going to shoot – radar missiles, heat seekers or guns. Remember what I said about that radar? Well, when you move that switch the radar changes range mode. So if you select guns and the radar was in 80 mile range mode, it immediately shifts to 10-mile mode. When you select a weapon, you automatically select everything else that's necessary to fire that weapon.

Then there's the thumb wheel that controls the tilt of the radar antenna, so you can look down, or straight out or up and around the side of that is a toggle that drops flares or chaff for self-defence. There's also the control for the cursor on the radar scope that designates the target you want to lock-on to… You've got more controls on the stick (but not as many as 13) so everything's where you need it. Best of all they are just inputs to the computer system, so they can be changed. Some of our guys wanted different lock-on modes for their radar. So one Friday evening we parked our aircraft up as usual and by Monday morning the new switch set-up was ready to go…

All of this combines to give you a great feeling of confidence in the aircraft. You sit in the big, roomy cockpit of an F-15, up high, looking out over the world with a great radar and all the rest and you feel like you can go out and shoot anybody. It's the best airplane we've built in a long time. It sits right there with the classic P-51 Mustang and F-86 Sabre.

BELOW: Still going strong: Don's claim in the early 1980s, that the Eagle was up there with the Mustang and Sabre, has been proven correct…

A medium-range Sparrow streaks towards its target.

DISSIMILAR FIGHTING AND FAKE CANOPIES

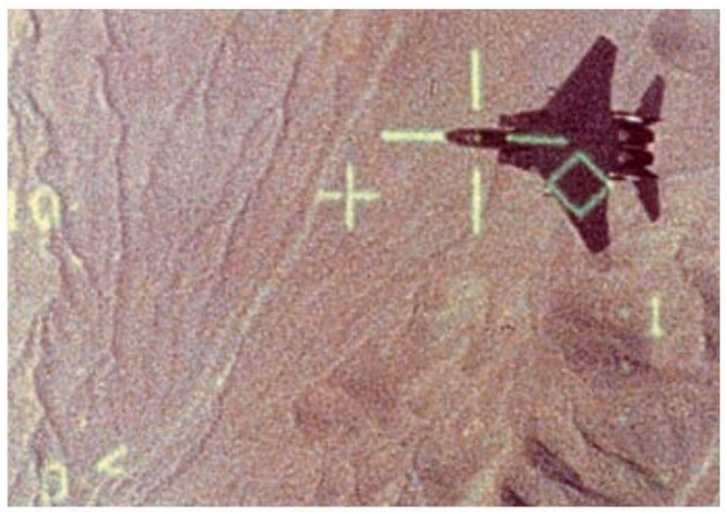
Much was made of the Eagle's prowess as an air-to-air fighter, but – at least initially – much of the 'trade' or competition would come from the other 'teen' series of US fighters, at least until the Israeli Air Force blooded the F-15A in 1979.

But on entry into USAF service questions were being asked – both in The Pentagon, and out in the wings and on the carriers themselves: could the F-15 be bested by a Grumman F-14A Tomcat? Was the General Dynamics F-16 Fighting Falcon the best close-in dogfighter ever? Or was McDonnell-Douglas' own F/A-18 Hornet – with its accent on the high-alpha dogfight – the machine to beat?

Of course, inter-service rivalry accounted for a lot, in the early days. Who would win? The F-14 with its Phoenix long-range missile or the F-15 with its recalcitrant Sparrows?

The answer – of course – is that the best pilot or crew often wins and, sometimes, you'd find a good F-4E driver and his Whizzo taking down a new Eagle pilot on exercise. The Eagle versus Tomcat was an interesting one (learn what the Israeli Air Force felt about both in a later chapter) but it's interesting to hear stories from 'the other side.' This one illustrates experience over youth…

Dave 'Bio' Baranek is a legendary (now retired) F-14 RIO (Radar Intercept Office) instructor and keen photographer. He recalls: "Some days everything falls together. We're on a Key West detachment and we're tasked with flying some four versus four with F-15s out of Tyndall. They're up in the Florida pan-handle, so we're in the areas over the Gulf of Mexico. They're students… we figure we'll give them a lesson.



ABOVE: An Eagle in an 'enemy' gunsight.

"So after the phone brief, we get off early and fly low, right up the middle of Florida instead of going north over the water. They're all scanning south and we come at them low from their nine-o-clock. We shoot them all with Sparrows before they know we are there, then, we pull into them and kill them again with Sidewinders. These guys had an instructor in the back of the two-seaters who said he saw us. I'm not so sure, but that's okay. The AIM-54 Phoenix wasn't in the rules, but for the hell of it we shot them all down from somewhere over Disney World: our radar was just perfect."

Another classic Cat versus Eagle story comes from the many such legends from Joe 'Hoser' Satrapa. As a kid he was good with a rifle, then when flying the F-8 Crusader his instructor saw how he just 'hosed' or sprayed bullets at the towed target and proclaimed: "We've got a hoser, here…" As usual in the fighter community, the nick-name stuck.

By the time 'Hoser' was in the F-14 Tomcat community he was the stuff of legend. During his notable gunnery debriefs, he would show a slide (not this one illustrated) where the pipper of an F-14 was over the centre of the F-15 Eagle's huge wing… he'd ask the students: "What's wrong with this picture?" It looked good to them… Hoser would answer: "The pipper isn't on the GODDAMN CANOPY! No kill like a guns kill! Pull on the pole until the rivets pop and the RIO pukes!" Rumour was that – such was his finesse with the big Tomcat during gunnery and his performance against the F-15 Eagle, the Japanese Self Defence Air Force almost switched to F-14s

and maintenance readiness as both pilots and ground crew got used to their new machines. DACT against other aircraft by now had moved beyond just the F-5s of the Nellis-based aggressor squadron and included Northrop T-38 Talons, Navy F-4s (J/S models) USAF F-4Es and F-106 Delta Darts. In the meantime more wings were activated with the Eagle, including the 57th based out of Nellis (WA tail codes) the 32nd Tactical Fighter Squadron at Soesterberg, Holland (CR tail code) and – in December 1978 – the 33rd TFW out of Eglin AFB, Florida with EG tail codes.

ENTER THE C AND D EAGLES

As the 1970s drew to a close F-15A and B models were growing in numbers in the USAF. By the end of 1977 the 49th TFW were receiving their Eagles and by now around 250 F-15s had been delivered, flying around 59,000 flight hours on 44,000 flights. As the F-15 matured, pilots and crew were becoming more adept at getting the best out of the aircraft, but already a new version was coming down the line.

The first F-15C, numbered 78-0468 first flew in February 1979 with the first F-15D following in June of that year. This was to be – effectively – the (still) ultimate version of this now venerable fighter. Changes were difficult to spot and mainly under the skin – but they were far-reaching. Firstly, the AN/APG-63 radar was improved with the addition of increased processing power. Additional internal fuel tanks gave yet more internal fuel, while a new ACES II (Advanced Concept Ejection Seat) bang seat made urgent departures from the Eagle more survivable. A strengthened undercarriage helped with a higher gross weight (68,000lb), while improved Pratt & Whitney F-100-220 engines gave around 24,000lb in afterburner. It also ushered in a new 'Digital Electronic Engine Control' (DEEC) and much better reliability.

The airframe was now allowed to go to 9G – not the previously limited 7.5G. FAST or 'Fuel And Sensor Tactical' scab-

The Eagle was often measured against the F-14 Tomcat.

rather than the planned F-15 purchase.

And then there's this account of an F-15C versus a brace of Canadian Hornets. The CF-188s (the Hornet name isn't officially recognised in Canada) uses extra equipment, such as a spotlight in the left-hand side of the forward fuselage to identity intruders at night and a fake cockpit painted under the forward fuselage.

Now, this wasn't new. It had been seen on F-4J/S Phantoms painted by noted aviation artist Keith Ferris. He got together with a number of pilots – including noted TOPGUN instructor C J 'Heater' Heatley to come up with disruptive camouflage patterns which would help during close-in dogfighting. One aspect of this was the 'false canopy', painted under the forward fuselage to fool a pilot into knowing which attitude and direction the opposing fighter was at or going in. Some F-4s used this gimmick and all Canadian Hornets do – as do some Fairchild-Republic A-10A/C Thunderbolt IIs.

F-15s stationed in West Germany before the end of The Cold War would learn to appreciate the 'false canopy' as they would often find themselves taking part in Dissimilar Air Combat Training (DACT) against any NATO elements in the area – and that included the Canadian Hornets then based at Baden-Soellingen.

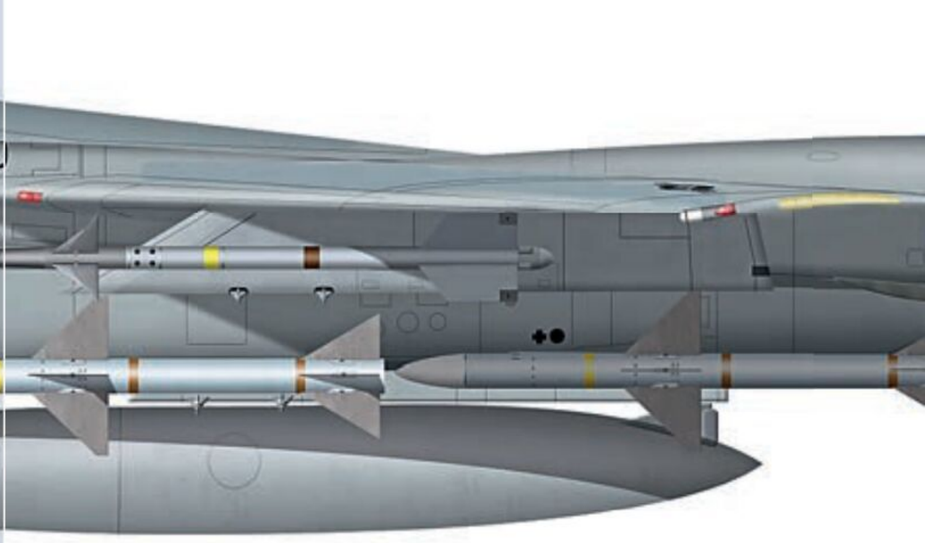
F-15C pilot Robert 'Scout' Winebrenner was part of the 32nd Tactical Fighter Squadron in Soesterberg, Holland, and he recalls how useful the 'fake canopy' was during a joint mission with a CF-188 flown by Captain Greg 'Claw' Morris. Winebrenner recalls: "After checking the applicable national regulations, we determined that it was not allowed to fly dissimilar close formation. But there were no prohibitions on dissimilar tactical formations. So we found the best weather on Low Fly Area (LFA) 7 in southern Germany, and briefed up a low-altitude VFR ingress through France at slower speed to save fuel, intercepts on target of opportunity in LFA7, and a high altitude recovery to individual instrument approaches at Florennes."

When they reached the low-fly area, other aircraft were using the zone and both the F-15C and the CF-188 flew several engagements against Phantoms, F-16s and some Tornados. Both the F-15 and F/A18/CF-188 and their pilots worked well together – but soon Winebrenner realised his 'flying tennis court' was easier to spot than the smaller F-18 Hornet. He realised that at 'the merge' the bogeys would react to the bigger F-15 and then the enemy formation would begin looking for the 'second Eagle' – leaving Morris able to take plenty of close-range missile and gun shots.

This play-through was the same when another pair of Canadian Hornets showed up, they didn't spot Morris in his Hornet and – instead – went two versus one against what they thought was Winebrenner's lone F-15. Laughing, Morris quickly communicated to his compatriots to check their six, as Winebrenner recalls: "Hey, what are YOU doing back there? I'm with the F-15! Fox 2 on both of you!"

Winebrenner retired in 2005 after 26 years in the USAF and he says: "Now my only exposure to the Hornet is watching the US Navy Blue Angels practice over my home in Pensacola. I did note disappointedly that they don't have the fake canopy!"

LEFT: It's easy to see how the fake canopy on the Canadian F/A-18/CF-188 could fool the enemy in a dogfight.



***ABOVE:** This F-15A served with the 5th Fighter Interceptor Squadron, USAF at Minot Air Force Base, North Dakota in 1985. The unit was active between 1984 and 1988.*

tanks could be used – but could not be jettisoned – bolted as they were to the main intake trunks. The overall weight of the F-15C went up by just 650lb and the first C/Ds seamlessly rolled off the production lines at McDD at the end of 1979, allowing the earlier models to head to the Air National Guard units. As old as even the youngest C/D models are, they would receive constant upgrades of their own to stay current with modern threats.

***LEFT:** Originally called 'Fuel And Sensor Tactical' (FAST) packs, the conformal fuel tank would be standard on later fighter-bomber Eagles but only seen on Alaskan 'Albino' (fighter) F-15s.*

SATELLITE KILLER!

With the F-15's phenomenal climb performance – and with US Defence in the 1980s heading in a 'Star Wars' sort of direction, one of the strangest ideas was the use of the Eagle as a destroyer of spy satellites

In the late 1970s the 'ASAT' or 'Anti-Satellite' mission was looked at, some years before the Strategic Defence Initiative (SDI) which was known as 'Star Wars.' The F-15's ASAT mission would take an F-15, loaded with a single Ling-Temco-Vought ASM-135 ASAT missile and launch it in a zoom climb to take out any offending satellite.

The missile itself was a three-stage guided weapon. The first stage utilised a Boeing AGM-69 Short Range Attack Missile (SRAM) motor and Vought's Aerospace Altair 3 rocket as the second stage. The third stage was the homing vehicle, which – using infra-red – would target and intercept the satellite. Initially the ASM-135 ASAT was built without a warhead – as kinetic energy alone would do the job of destroying the satellite. The ASM-135 was around 18ft long and weighed 2700lb. The launch Eagle had to be fitted with a back-up battery for the ASAT weapon, a small computer system and data-link for guidance.

The first and only time a satellite was destroyed by an F-15 came on September 13, 1985, when an F-15A Eagle (76-0084) nick-named 'Celestial Eagle' piloted by Major General (then Major) Wilbert D 'Doug' Pearson Junior took off from Vandenburg Air Force Base, California and destroyed the Solwind P78-1 satellite, which the US had only launched some six years before, but was having issues with depleted batteries.

Pearson was an experienced 'stick' being a test pilot and having more than 4000 flying hours in 50 different aircraft, including (later) the F-22 Raptor, T-38, Northrop F-20 Tigershark, F-4 and F-15, before his retirement in 2005. He also had more than 350 combat hours over Vietnam.

The F-15 was flying straight and level at around Mach 1.2 when Pearson pulled 76-0084 into a 4G zoom climb at an angle of 65 degrees. At around 38,000ft, with the aircraft's speed decaying just below the speed of sound, the ASAT missile was launched automatically. At 1.42pm, the third stage of the ASAT missile hit the Solwind P78-1 satellite at an altitude of 345 miles, 200 miles west of Vandernberg AFB and at a speed of more than 13,000 miles per hour. The satellite was completely destroyed.

Despite this success, the adoption of the ASAT role for the F-15 (it was thought that the 48th Fighter Intercept Squadron and the 318th FIS were to be so equipped) did not happen. Congress eventually banned further testing of the missile due to a Soviet/US

***ABOVE:** The ASAT was 18 feet long and married three stages in its construction.*

RIGHT: *Vision from the F-15's cockpit was surpassed only by the later F-16…*

F-15 FACT

Not a single F-15 fighter aircraft has been lost during air-to-air combat

"The F-15 became the only machine (so far) to 'kill' a satellite when - in 1985 - it launched an ASAT at Solwind P78-1."

ABOVE: *Retired Maj. General Doug Pearson and his son Capt. Todd Pearson in front of the 'ASAT' F-15A that both flew.*

agreement about testing weapons in space and the programme officially ended in 1986.

For 'Celestial Eagle' it wasn't the end and the aircraft was still in service 22 years later, being assigned to the 125th Fighter Wing of the Florida Air National Guard. On the 22nd anniversary of that unique mission on September 13, 2007, Major General 'Doug' Pearson was reunited with the aircraft which was flown that day by his son, Captain Todd Pearson. Celestial Eagle was eventually mothballed at the Davis-Monthan Air Force Base 'Boneyard' in August 2010.

RIGHT: ***Doug Pearson launches the missile at the satellite. It had no warhead – kinetic energy alone would do the job.***

ABOVE: The Flanker family – like the F-15 – has proliferated and been sold worldwide.

THE SOVIET EAGLE

The kill ratio that the F-15 Eagle has is more than just a number – it's almost sacrosanct. So is suggesting that any Soviet/Russian-built, Chinese or European fighter could take an Eagle down.

With a kill ratio of around 107-0 (depending on stats) both the fighter and strike versions of the Eagle are still seen as being at – or around – the 'top of the tree' when it comes to fighter-versus-fighter combat, but there is one aircraft that casts a similarly large shadow over the F-15… and that aircraft is the Sukhoi Su-27/Su-35 Flanker.

By the late 1970s, a number of new Soviet designs were being seen at the test airfield at Ramenskoye and these were codenamed RAM followed by a number. RAM-L was a Mikoyan-Gurevich design, which became the agile MiG-29 Fulcrum, while the similarly-shaped RAM-K was the Sukhoi T-10, later Su-27 – known as the 'Flanker'. This aircraft was similar in size and purpose to the F-15 Eagle, long-range air-superiority.

Unlike the Eagle – or even the MiG-29 – the Su-27 had a difficult entry into service and was, effectively, one of the last 4th-generation fighters to enter widespread service in the mid to late 1980s, by which time Fulcrums had often been spotted and intercepted over eastern Europe as well as having visited a number of friendly neighbours.

The Flanker itself features two large turbofan engines – the Saturn/Lyulka, rated in afterburner with around 27,000lb of thrust – a few thousand pounds more than the Pratt & Whitney F-100-200 series. Interestingly, more like the F-14 Tomcat than the Eagle, both engines are more widely-spaced on the Russian fighter, meaning that the Eagle has the better asymmetric handling characteristics should an engine be lost.

During development both the new MiG-29 and Su-27 were to have their own powerful pulse-doppler 'look-down-shoot-down' radars, meaning they were less reliant on ground control intercept (GCI) than previous Soviet fighters. The Su-27's weapons fit included a 30mm cannon and a wide-range of air-to-air missiles, including infra-red 'heat-seekers' and radar-guided medium range missiles.

Similarly to the F-15, the weapons fit of the Flanker was improved, so – as the F-15 moved from Sparrows to AMRAAMs and AIM-9L/M Sidewinders to off-boresight aimed AIM-9X Sidewinders, so too did the Flanker see improvements to its missile fit with its own hyper-agile short range missiles and active radar homing medium range missiles.

More importantly the big Sukhoi has probably had the edge when it comes to growth potential in the basic airframe. While the Eagle did transform itself into the Strike Eagle, the Flanker itself also became a strike aircraft. The multi-role Su-30 family perhaps mirrors the Strike Eagle best, while the side-by-side seating Su-34 long-range interdictor was used as a replacement for the swing-wing Su-24 Fencer and had such long legs that the crew of two even had a galley and a toilet positioned behind the cockpit area!

Furthermore, the Su-27 family spawned a number of naval variants (Su-27K/Su-33), suitable for use on Russia's carriers and advanced fighter versions of the basic airframe which incorporate canards and thrust-vectoring (Su-35/37.) Each model has had a modicum of success and around 1700 have been built for more than 12 operators across the globe, including some licence-built in China.

In some respects, the Flanker has had the edge over the Eagle: modern versions, albeit not yet ordered in any numbers, feature engines with around 32,000lb of thrust and – of course – an IRST (Infra-Red Search and Track) system, where 'radar-off' intercepts can be carried out. Only now is the F-15 fighter community getting such a system. It can also be capable of supersonic speeds at some weights without the use of afterburner – the so-called 'supercruise'. Radar-wise the latest AESA (Active Electronically Scanned Array) radars still hand the advantage of avionics to the Western fighter.

Pure stats show the Flanker to have a 6:0 kill ratio, which isn't a patch on the 100+:0 that the Eagle is reported to have. But what would a well-flown Flanker do to an Eagle? You can bet that this has already happened, probably in the skies above the US. It's reported that two Su-27 airframes were purchased from a former

ABOVE: Eagles would become the plumb placement for new and experienced USAF pilots alike in the late 1970s and early 1980s.

BELOW: The F-15A and B models would be replaced in the late 1970s by the superior C and D.

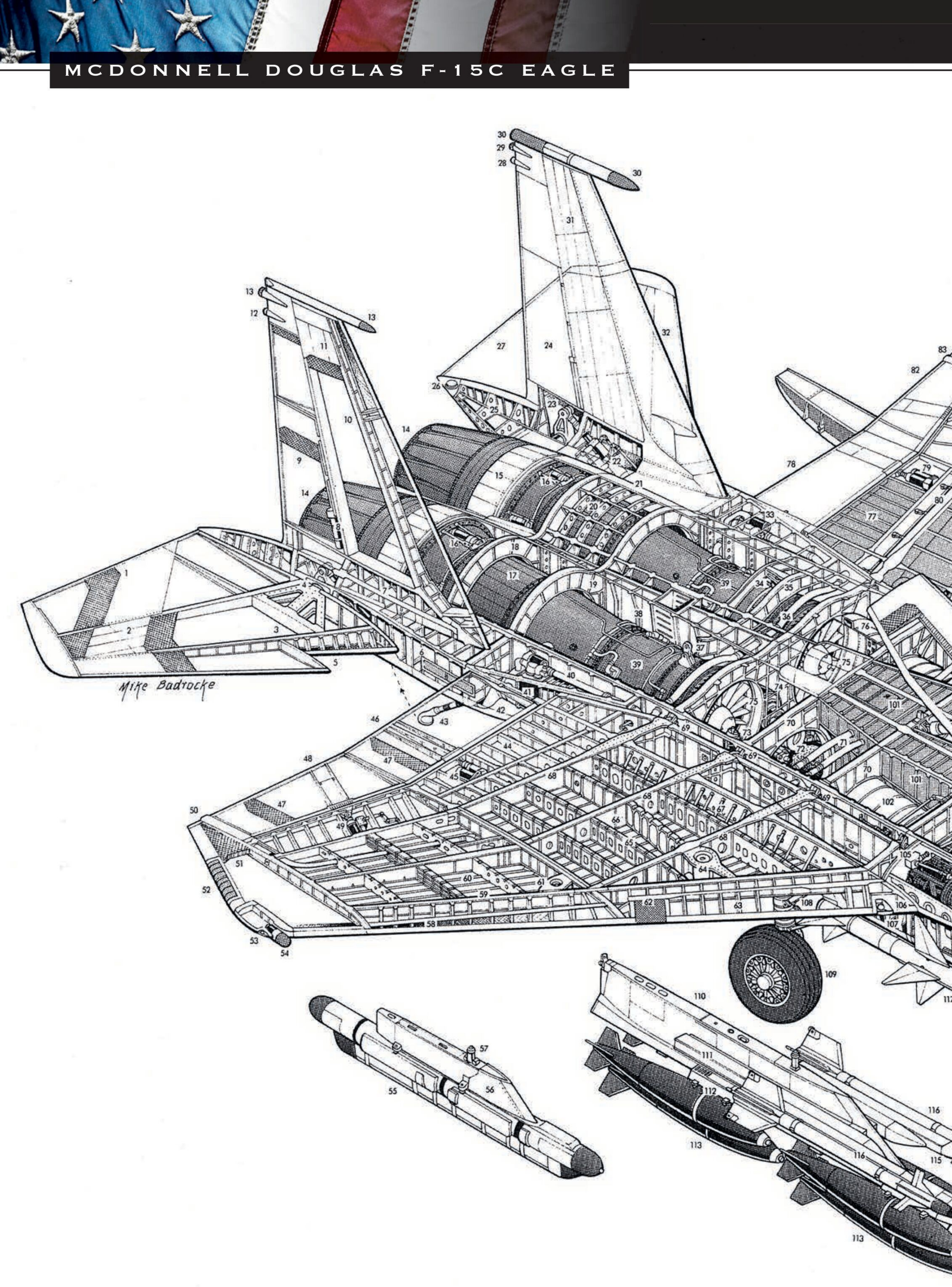
F-15 FACTS

The last F-15A was finally retired from service with the Air National Guard in 2009.

Soviet-bloc country and shipped to the USA. These were reported to have been used as 'silver bullet' DACT (Dissimilar Air Combat Training) types for the USAF and US Navy's fighter community. It's thought that many of the Russian systems have been swapped out for Western systems and controls/gauges have changed to English ones.

For decades the shadowy 'Red Hats' squadron has flown captured or procured MiG types since the 1960s. It's rumoured that Lt Colonel Eric 'Doc' Schultz – himself a former and much decorated F-15E pilot and F-35 Lightning II test pilot – may have been killed flying an Su-27-derived airframe in September 2017. Nothing was confirmed, but the fact that it took three days to acknowledge the tragic accident and that the type of aircraft involved wasn't confirmed (other than it was NOT an F-35) raises more questions than it provides answers.

BELOW: In response to the Flanker, F-15s were used in the adversary/aggressor role as Flanker simulators – often with perfect replica colour schemes! This F-15D is from the 65th Aggressor Squadron, which was active between 2005 and 2014.

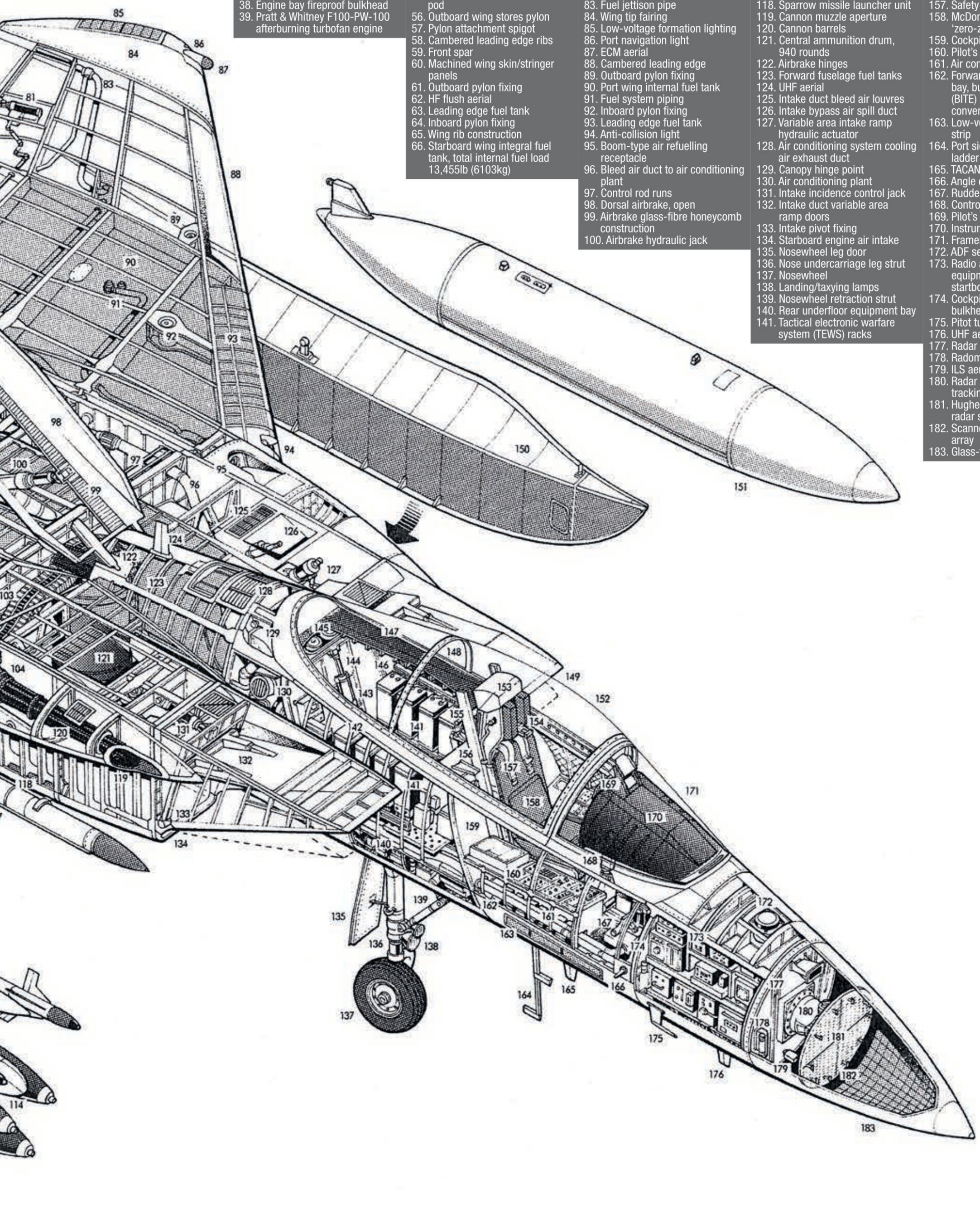


MCDONNELL DOUGLAS F-15C EAGLE

Mike Badrocke

McDonnell Douglas F-15C Eagle

1. Tailplane honeycomb construction
2. Boron fibre skin panel
3. Tailplane spars
4. All-moving tailplane pivot fixing
5. Leading edge dog-tooth
6. Low-voltage formation lighting strip
7. Fin root attachment frames
8. Rudder hydraulic rotary actuator
9. Rudder honeycomb construction
10. Fin spar construction
11. Boron fibre skin panel
12. Anti-collision light
13. Electronic countermeasures aerials (ECM)
14. Variable area afterburner exhaust nozzles
15. Nozzle sealing flaps
16. Fueldraulic nozzle actuators
17. Afterburner duct
18. Engine bay titanium ring frames
19. Rear engine mounting frame
20. Engine bay titanium frame and stringer construction
21. Titanium skin panelling
22. Port tailplane hydraulic actuator
23. Tailplane hinge arm
24. Port rudder
25. Tailboom fairing
26. ECM aerial
27. Port tailplane
28. Tail navigation light
29. ECM aerial
30. Radar warning aerials
31. Boron fibre skin panelling
32. Fin leading edge
33. Port air system equipment bay
34. Forward engine mounting
35. Engine mounting frame
36. Bleed air system ducting
37. Engine support link
38. Engine bay fireproof bulkhead
39. Pratt & Whitney F100-PW-100 afterburning turbofan engine
40. Starboard air system equipment bay
41. Engine bleed air primary heat exchanger
42. Heat exchanger ventral exhaust duct
43. Retractable runway arrester hook
44. Wing trailing edge fuel tank
45. Flap hydraulic jack
46. Starboard plain flap
47. Flap and aileron honeycomb panel constructon
48. Starboard aileron
49. Aileron hydraulic actuator
50. Fuel jettison pipe
51. Aluminium honeycomb wing tip fairing
52. Low-voltage formation lightning
53. Starboard navigation light
54. ECM aerial
55. Westinghouse ECM equipment pod
56. Outboard wing stores pylon
57. Pylon attachment spigot
58. Cambered leading edge ribs
59. Front spar
60. Machined wing skin/stringer panels
61. Outboard pylon fixing
62. HF flush aerial
63. Leading edge fuel tank
64. Inboard pylon fixing
65. Wing rib construction
66. Starboard wing integral fuel tank, total internal fuel load 13,455lb (6103kg)
67. Wing root rib support struts
68. Titanium wing spars
69. Wing spar/fuselage attachment pin joints
70. Machined fuselage main bulkheads
71. Wing/fuselage fuel tank interconnections
72. Airframe mounted engine accessory gearbox
73. Standby hydraulic generator
74. Jet fuel starter (JFS)/auxiliary power unit (APU)
75. Engine intake compressor face
76. Cooling system intake bleed air spill duct
77. Port wing trailing edge fuel tank
78. Port plain flap
79. Flap hydraulic jack
80. Aileron control rod
81. Aileron hydraulic actuator
82. Port aileron
83. Fuel jettison pipe
84. Wing tip fairing
85. Low-voltage formation lighting
86. Port navigation light
87. ECM aerial
88. Cambered leading edge
89. Outboard pylon fixing
90. Port wing internal fuel tank
91. Fuel system piping
92. Inboard pylon fixing
93. Leading edge fuel tank
94. Anti-collision light
95. Boom-type air refuelling receptacle
96. Bleed air duct to air conditioning plant
97. Control rod runs
98. Dorsal airbrake, open
99. Airbrake glass-fibre honeycomb construction
100. Airbrake hydraulic jack
101. Centre fuselage fuel tanks
102. Intake ducting
103. Ammunition feed chute
104. M61A-1 Vulcan 20mm cannon
105. Hydraulic rotary cannon drive unit
106. Starboard anti-collision light
107. Ventral main undercarriage wheel bay
108. Main undercarriage leg strut
109. Starboard mainwheel
110. Inboard stores pylon
111. Air-to-air missile adaptor
112. Bomb rack
113. Mk 82 low drag 500lb (227kg) HE bombs
114. Bomb triple ejector rack
115. Missile launch rail
116. AIM-9L Sidewinder air-to-air missile
117. AIM-7F Sparrow air-to-air missile
118. Sparrow missile launcher unit
119. Cannon muzzle aperture
120. Cannon barrels
121. Central ammunition drum, 940 rounds
122. Airbrake hinges
123. Forward fuselage fuel tanks
124. UHF aerial
125. Intake duct bleed air louvres
126. Intake bypass air spill duct
127. Variable area intake ramp hydraulic actuator
128. Air conditioning system cooling air exhaust duct
129. Canopy hinge point
130. Air conditioning plant
131. Intake incidence control jack
132. Intake duct variable area ramp doors
133. Intake pivot fixing
134. Starboard engine air intake
135. Nosewheel leg door
136. Nose undercarriage leg strut
137. Nosewheel
138. Landing/taxying lamps
139. Nosewheel retraction strut
140. Rear underfloor equipment bay
141. Tactical electronic warfare system (TEWS) racks
142. Cockpit coaming
143. Rear pressure bulkhead
144. Canopy jack
145. Cockpit pressurisation valves
146. Structural space provision for second crew member (F-15D)
147. Cockpit aft decking
148. Canopy arch
149. Port intake external compression lip
150. Fuel and sensor tactical (FAST) pack, conformal fuel pallet, capacity 5000lb (2268kg)
151. 600 US gallon (2270 litre) external fuel tank
152. Cockpit canopy cover
153. Ejection seat headrest
154. Seat safety handle/arming lever
155. Canopy emergency jettison linkage
156. Ejection seat launch rails
157. Safety harness
158. McDonnell Douglas ACES II 'zero-zero' ejection seat
159. Cockpit sloping bulkhead
160. Pilot's side console panel
161. Air conditioning ducting
162. Forward underfloor equipment bay, built-in test equipment (BITE) and liquid oxygen converter
163. Low-voltage formation lighting strip
164. Port side retractable boarding ladder
165. TACAN aerial
166. Angle of attack probe
167. Rudder pedals
168. Control column
169. Pilot's head-up display (HUD)
170. Instrument panel shroud
171. Frameless windscreen panel
172. ADF sense aerial
173. Radio and electronics equipment bay, port and startboard
174. Cockpit front pressure bulkhead
175. Pitot tube
176. UHF aerial
177. Radar mounting bulkhead
178. Radome hinge mounting
179. ILS aerial
180. Radar scanner mounting and tracking mechanism
181. Hughes APG-63 pulse doppler radar scanner
182. Scanner mounted IFF aerial array
183. Glass-fibre radome



EXPORT EAGLES

The all-new McDonnell Douglas F-15 Eagle would have been a logical choice on the export market for existing F-4 Phantom II operators in the late 1970s, but only a few could initially pay the price for the early 'pure fighter' version.

The F-15 Baz fleet has been the backbone of the IAF since the late 1970s.

IAF Baz aircraft scored the Eagle's first air-to-air kills and have been constantly upgraded over the last 40 years.

CHAPTER 4 – EXPORT EAGLES

During the early 1970s and with the F-15A and B Eagle nearing service entry with the United States Air Force, it was clear that sales could be had on the export market.

McDonnell Douglas was still manufacturing the F-4 Phantom II which was still selling well as – arguably – the world's best air-superiority fighter and they were also still producing the latest versions of the venerable A-4 Skyhawk and it would be a customer operating both of these machines that would become the Eagle's first export customer.

Historically, up until the late 1960s, the Israeli Defence Force/Air Force (IDF/AF) ran on a combination of French-built machinery, but that soon changed. Israel had turned to France for its combat aircraft from the mid-1950s, purchasing the Dassault Mystere IVA in 1956 which stayed in service until the 1970s. Other French-built aircraft included the Fouga Magister jet trainer, the Dassault Super Mystere – first delivered in 1959 – and the Dassault Ouragan, which saw service during the Suez Crisis. Of all the French

***ABOVE:** A large number of F-15 Baz airframes have individual kills marked on them.*

The IAF's use of in-flight refuelling was key to the success of its F-15 operations.

F-15 FACTS

The Israeli Air Force were the first to use the Eagle in combat anywhere in the world.

military aircraft used by the Israeli Air Force, the most famous was the Dassault Mirage IIICJ which was a spectacular success during 1967's Six-Day War.

The United States had – up until now – blocked the sales of military equipment to Israel, apart from 'defensive' systems such as the HAWK surface to air missiles which were sold to the IAF in the early 1960s, but – finally – in 1967 the go-ahead was given for the newly-merged McDonnell Douglas to sell a purpose-built version of the A-4 Skyhawk, the A-4H, to the Israelis. For the IAF this was a big move. The Skyhawk would be a perfect replacement for the ageing subsonic French jets now used in the air-to-ground role and the aircraft itself was well-proven in Vietnam.

The A-4H model – called 'Ayit' or 'Eagle' in Hebrew – was basically an A-4E, with an improved J52-P-8A engine, different avionics and two DEFA 30mm cannon in place of the original E-model's Mk 12 20mm Colts. The IAF would become the second largest operator of the Skyhawk after the United States and they would upgrade the aircraft in many ways, including the fitting the dorsal 'camel hump' avionics spine and an extended jet pipe designed to fool heat-seeking missiles. Around 90 H-models were delivered and augmented in 1973 with the A-4N model, a derivative of the US Navy/Marine's improved A-4M as well as two-seat versions. The type

> ***"Israel was in the market for a fighter – and a good one – as historically and geographically they were surrounded by enemies."***

Despite many upgrades under the skin, Israel's Baz fleet has had a hard life!

CHAPTER 4 – EXPORT EAGLES

> *"While not quite up to the tech levels of USAF F-15s, Saudi Eagles proved their capability when a pilot downed two Iraqi Mirage F-1s in Desert Storm."*

ABOVE: ***Allowing the Royal Saudi Air Force to buy the F-15 was a controversial decision.***

was finally retired in December 2015.

The choice of the A-4 finally meant that Israel didn't have to rely completely on France for her military aircraft – which was handy as during the late 1960s the French placed an embargo on sales to Israel. This embargo meant that the IAF did not get the Mirage Vs that it had ordered: this was a simplified version of the Mirage III, more suited to Israel's needs. Instead, Israel courted the US still further and pressed ahead with its own indigenous fighter-bomber based on the design of the Mirage V, which would lead to the Nesher/Dagger and Kfir strike fighters.

By 1969 the US had decided to allow the Israelis to purchase top-line McDonnell Douglas F-4E and RF-4E aircraft. The F-4E cost around four-times that of the little Skyhawk and was then the best multirole fighter in the world. The F-4E was called 'Kurnass' (Heavy Hammer) in Israeli service and would keep air-superiority for the IAF in the Middle East, joining the fight during 'The War of Attrition' and taking heavy losses during the Yom Kippur War. The last Kurnass was retired in 2004.

As the 1960s came to a close, the IAF knew that they had to have an eye on the future when it came to new fighter aircraft, more so when the new decade dawned and the Soviets began to fly MiG-25 recce aircraft over Israel from 1971. Initially the Israelis would work with the US/McDonnell Douglas on trying to develop a higher-performance F-4 model – known as the F-4X: this had uprated J-79 engines equipped with water-cooling, allowing for higher cruising speeds and a top speed of around Mach 3.2. While this would be a solution for Israel, by the early 1970s an updated and uprated F-4 Phantom II would or could spell disaster for the F-X/F-15 programme back in the USA.

The IAF soon had its own team looking at future fighter aircraft designs, while at the same time diplomatic overtures were being made to Washington in a bid to ensure that they wouldn't have to wait for eight years (as they had with the Phantom) before getting the chance to purchase any modern US fighter design. Meantime, Israeli Aircraft Industries pressed on with the J-79-powered Kfir Mirage derived strike-fighter and even looked ahead to its own, more modern design which – in the 1980s – became the IAI Lavi. Senior figures in the

***ABOVE:** F-15 models are in pride of place in the RSAF.*

IAF knew that any Israeli-designed and built aircraft would take some 10 or more years to develop and – even then – have to use avionics, parts and engines from the West.

In the 1970s, the US was always trying to 'tread carefully' in the Middle East. Strange as it may seem today, back then they were trying to ensure and maintain the balance of power in the region. Following the Yom Kippur War ceasefire in October 1973, the UN-backed agreement between Israel and Egypt in January 1974 and then the subsequent Israeli withdrawals and second disengagement agreement signed in September 1975, the portents were good that Israel would be looked upon favourably by the US government on any potential 4th generation fighter purchase.

The requirement was for around 50, 4th generation fighters to see the IAF through to the 1990s – perhaps beyond. In June 1974 the country's minister for defence – Shimon Peres – requested that a small cadre of experienced IAF pilots be allowed to test and evaluate the two main contenders to such a purchase. Those candidates would be the Grumman F-14A Tomcat and the McDonnell Douglas F-15A/B Eagle.

By this time the F-14A had already been evaluated and ordered by the Iranian government – the Shah (a pilot himself) was supposedly impressed by the aircraft's performance and at the time the order wasn't such an issue – until the 1979 revolution. The differences between the F-14 and F-15 included that the Tomcat

F-15 FACTS

With the production line open until at least 2022, the last Eagle could be flying as late as 2050!

***ABOVE:** The RSAF has been a keen customer for modern F-15 models.*

was designed around the AIM-54 Phoenix, a 100-mile missile that helped to give the F-14A the reach to defend the fleet against long-range Soviet bombers and cruise missiles. In the right hands it could also dogfight… On the other hand the F-15 was designed for air-superiority over the battlefield – something that appealed to the Israelis when you consider the battles they had fought since independence in 1948, but both would be evaluated thoroughly.

IAF commander Benny Peled had flown one of the first TF-15s in 1974, but this was a pre-production jet, so many of the systems to make it combat-ready were not actually fitted to the aircraft. Meanwhile, David Ivry (a former P-51 Mustang and Dassault Ouragan pilot for the IAF) had also flown a Tomcat while visiting Naval Air Station Miramar. He's reported to have been impressed with the F-14, if a little disappointed at the fact that the troublesome TF-30 turbofans had to be treated with care during air combat manoeuvres with a US Navy A-4 Skyhawk.

A team was eventually put together to evaluate both machines independently as the US had not allowed the Israelis to actually pitch Tomcat against Eagle. The evaluation team would be led by Amnon Arad – a former Mirage pilot and F-4E pilot and squadron leader. He would be joined by Assaf Ben-Nun (former fighter pilot and test pilot for the Kfir project), Omri Afek – an F-4E pilot, Israel Baharav – former Mirage pilot and squadron commander during the recent Yom Kippur War and navigator Aharon Katz. The rest of the team included ground crew and

CHAPTER 4 – EXPORT EAGLES

A brace of indigenous Mitsubishi F-1s fly with a USAF PACAF F-15.

employees from Israeli Aircraft Industries.

The evaluations would make for interesting reading at the time – coming from the most experienced and battle-hardened jet fighter pilots then seen: these pilots had around 24 kills between them. They wanted to see how these teen-series jets dealt with everything from low and slow targets to fast targets replicating the irritating MiG-25Rs that were making nuisance flights over Israel.

Around 10 flights were made in the two-seat F-15 – a full-scale development aircraft with the new systems on board – as well as extensive use of the McDD F-15 simulator. Sorties were made against both A-4 and F-4 aircraft and the Israelis came away impressed with the F-15 especially. They found that the F-15 could easily best both aircraft, that the weapons systems were 'user-friendly', that the agility of the Eagle was astounding and that the power allowed them to 'sustain G' like nothing else they'd flown before. The cockpit also gave unrivalled visibility for dogfighting.

In comparison with the two-seat F-14 which the team flew at Miramar, they were disappointed in the dogfighting ability of the Tomcat – something the IAF excelled at. Often it was found that an air combat manoeuvring mission against the humble A-4 Skyhawk could end up in a stalemate. It soon became clear that the F-15 Eagle was the best choice for the IAF and – better still – the aircraft was some millions of dollars cheaper per unit than the Tomcat.

Politically though, issues over an F-15 sale would not be cleared until that second disengagement agreement of September 1975, but then within a month the US agreed to supply the Eagle in numbers. Under the terms of the agreement, entitled 'Peace Fox I', Israel began receiving its new fighter in the form of four full-scale development aircraft in December 1976, followed up by the delivery of two F-15Bs and 19 F-15As under the terms of Peace Fox II. This would cost Israel around $625 million and was superseded by Peace Fox III where 18 F-15Cs and eight F-15Ds were ordered. In addition – during the early 1990s – following Israel staying its hand during Desert Storm when it was attacked by Iraqi Scud missiles, the IAF was sent 10 early F-15A and Bs which were refurbished as a 'thank you' by the US government.

Israel's investment in the F-15 Eagle proved to be well worth it, as we shall see.

SAUDI EAGLES

By the end of the 1970s, the Royal Saudi Air Force was in need of a fighter to replace the

***ABOVE:** The F-4EJ Phantom was locally built, as was the F-104 Starfighter before it.*

"*The balance of power was the number one aim of the US in the 1970s, so both Israel and Saudi Arabia would eventually be able to buy F-15 Eagles.*"

notoriously short-legged BAC Lightnings which were originally delivered in 1967 and would stay in service until 1985.

Traditionally, the RSAF used a mix of British/European and American warplanes and by the early 1980s that trend seemed set to continue, with Riyadh expressing interest in both the Eagle and both versions of the European Panavia Tornado. This was a political necessity forced upon the RSAF thanks to the 'will we, won't we' attitude of President Jimmy Carter's administration – at senate level it had to be explained that any RSAF F-15s would be used 'defensively' rather than against – say – the Israelis.

With the Israeli Air Force receiving their F-15s in the late 1970s – and despite political pressure at home – it was eventually deemed fit to supply 47 F-15Cs and 15 F-15Ds under 'Project Peace Sun', and these were to be a direct replacement for the BAC Lightnings which – by now – had relinquished their air-to-ground roles and were used as pure interceptors. Deliveries began in early 1981 and the F-15s were declared operational later that year.

In the meantime, Ronald Reagan replaced Carter in the White House and that marked a big change when it came to selling advanced arms around the world. Suddenly a 'watered down' version of the General Dynamics F-16, powered by the F-4 Phantom's J-79 engine was replaced by top-performing F-100 powered F-16As for exports. Also, the US sold five Boeing E3 AWACs aircraft (Airborne Warning And Control) aircraft, six Boeing KC-135 air-to-air tankers, advanced missiles and the Conformal Fuel Tanks (CFTs) originally kept out of the first Peace Sun deal, in case they were used to extend the F-15's range for attack missions to Saudi Arabia. The sum total was billions of dollars and this regime change in the Oval Office extended to Israel as they could finally export their own IAI Kfir, equipped as it was with an American J-79 engine and they themselves could order extra fighters.

Interestingly, the further sale of F-15s to Saudi Arabia in 1983 was a hot enough potato for Congress to block the sale, effectively pushing the RSAF to select the RAF's version of the Interdictor Strike (IDS) version of the Tornado as part of the first 'Al Yamamah' arms deal of 1985, which also covered the Air Defence Variant (ADV) Tornado and Hawk trainers and associated weapons and equipment.

Saudi Arabia's original 'Peace Sun' order would be fulfilled by May 1983, with the last two of the 62 on order being attrition replacements. Then in October 1987 a further order of nine F-15C and three F-15Ds under 'Peace Sun VI' were ordered but these would not be delivered until February 1992 and after the Gulf War – although in the meantime, 24 used examples would be transferred to the RSAF during the summer of 1990. It is thought that these original air-to-air only fighters will be replaced either with Eurofighter Typhoon aircraft or later versions of the multirole Eagle.

FAR EASTERN EAGLES

Since the Second World War, Japan has been a key area in the West's anti-communist policies. From its use as a staging post and base during the Korean War, through to the alarming shoot-down of the KAL007 airliner shoot-down by a Sukhoi Su-15 in 1983, to today's increased tensions in the area, with both Chinese and Russian jets probing their defences: Japan's 'Self-Defence' forces have had to be ready.

For the decades preceding acceptance of the F-15 Eagle, Japan had a proud tradition of not only using their own, indigenous designs, but also the licence-production of top-line fighter aircraft from the United States.

Since the end of the Second World War, Japan's military aviation industry designed such capable

F-15 FACT

Japan would be the only nation that would licence-produce the F-15 Eagle.

CHAPTER 4 – EXPORT EAGLES

aircraft as the Fuji T-1, T-5, the Kawasaki T-4 and Mitsubishi F-1/T-2 while also licence-producing the latest fighters of the time, such as the F-86 Sabre, F-104 Starfighter, F-4 Phantom and – eventually – the F-15 Eagle.

During the early 1970s, the then-Japan Defence Agency (since renamed as the Ministry of Defence) looked at 13 possible aircraft to replace the Lockheed F-104J/DJ Starfighters that were ordered back in 1960 and the McDonnell Douglas F-4EJ Phantom II that was ordered in 1968.

Such was the pace of the selection process that the Japan Air Self-Defence Force (JASDF) sent a number of pilots to Edwards Air Force Base during June/July of 1975 to evaluate the F-15A and B aircraft. By the end of 1975 the F-15 Eagle was announced the winner of the competition to find a new Japanese defence fighter, called 'Peace Eagle' by the US.

With a few nations licence-building the F-104 (including Japan) and Japan licence-building the F-4EJ, it stood to reason that the Japanese aircraft industry would want to do the same with any selected fighter. With the government of Japan intending on initially having around 187 F-15 single and twin-seaters, it was announced in 1978 that Mitsubishi Heavy Industries would be the primary contractor for the production of the F-15C/D models – designated F-15J and DJ.

Eventually 223 aircraft would be acquired – 203 J model single-seaters and 20 DJ twin-stickers. Two F-15Js were built by McDonnell-Douglas at St Louis, with 12 DJs built in the US. The first F-15J flew in June 1980 before being sent to Japan and then eight F-15Js in large 'kit' form were shipped to Japan for final assembly, with the first of these flying in August 1981. From then all of the aircraft earmarked for Japan were licence-built and the first four squadrons to see service with the

Japanese F-15s are amongst the most colourful – thanks to their use in the aggressor role. The profile shows an aircraft as seen in 2013, flying out of Komatsu Air Base, Japan. The aircraft carries an AAM-3 drill round.

new fighter replaced the ageing F-104J Starfighter, with the Rinji F-15/202 Hokotai (basically a Japanese F-15 'operational conversion unit') the first to receive aircraft and form at the end of 1981.

When it came to the F-15J/DJ models, changes would be made to the basic design of the C/D Eagle – mainly thanks to the sensitive nature of certain items of equipment, mostly electronic countermeasures (ECM) kit, nuclear capability (still a factor on the early-model fighter versions of the F-15 Eagle) and the radar warning receiver (RWR.) To this end, the AN/ALQ-135 ECM suite of the US Eagle was eventually replaced with the Japan-derived J/ALQ-8, while the RWR fit in Japanese Eagles was taken care of by the J/APQ-4 system. Eventually, even the Pratt & Whitney F-100 engine was licence-produced in Japan.

Upgrades on the basic JASDF J and DJ aircraft began in 1987 with introduction of the basic USAF MSIP or Multi-Stage Improvement Programme. This saw the introduction of the P&W F-100-PW-220 (again, licenced-produced), an upgraded ECM suite, new computer systems, and upgraded J/ALQ-8 ICS system with a new antenna mounted under one of the engine intake trunks.

Upgraded and indigenous weapons also were absorbed by the F-15J/DJ force, including the upgraded Japanese-built AAM-3 missile, based on the AIM-9 Sidewinder, but with twin forward fins. Later upgrades of the F-15 fleet included uprated engines, new ejector seats, computer changes, introduction of the AAM-4 missile (similar to the US AMRAAM) and bringing the Raytheon AN/APG-63 radar more up-to-date. From around 2010 plans were put in place to make further upgrades, with helmet-mounted sights, a new AAM-5 short-range highly-agile missile and a full datalink system, meanwhile earlier JASDF plans to make an 'RF-15J' to replace the ageing RF-4E Phantoms were cancelled around the same time.

As it stands today, there could be plans to fully upgrade the existing fleet and bring them to (largely) F-15 2040C levels. With threats to Japan as great as ever, a refusal of the US to supply Lockheed-Martin F-22As, then with an ageing 'pure' fighter fleet and the Lockheed-Martin F-35 Lightning only trickling into service, it could be that an updated F-15J with around 16 air-to-air missiles could be protecting Japan's airspace for some time to come.

"It could be that updates to the Eagle will bridge any gap between Japan's 4th and 5th generation fighter fleets."

F-15 FACTS

Most export model F-15s do not have sensitive US electronics fitted.

BUILDING THE BEAGLE...

The Mud Eagle, the Beagle, the Mud Hen, Strike Eagle... names for the further-developed F-15 that would become the multirole aircraft it always had the potential to be.

Vapour boils over the wings and contrails extend from the wing-tips as the crew of this F-15E Strike Eagle work hard, low-down in the Mach Loop, Wales.

The second F-15E demonstrator was 'ole faithful' 71-0291 (see page 38) but this time in a wrap-around 'European 1' camouflage.

CHAPTER 5 – BUILDING A BOMBER

***ABOVE:** The latent air-to-ground capability of the F-15 airframe was developed but only so far, during the test phase.*

Not a pound for air to ground' was an adage bandied about in the Pentagon during development of the original fighter variant of the F-15 Eagle.

It was a call to make the Eagle an unadulterated pure fighter, something that – following the Vietnam War – many in the USAF felt that they needed to beat the pesky MiGs.

Of course the F-4 Phantom had been duly pulling double duties since the start of that conflict – and more. Both Navy and Air Force F-4s dropped bombs and napalm, fired rockets, engaged in Combat Air Patrols (CAPs) target combat air patrols (TARCAPs), went on escort missions, took part in 'Iron Hand' anti-surface to air missile missions, and did close support mission, often dropping ordnance within metres of their own troops. Specially-configured reconnaissance RF-4Bs, Cs would streak across the skies giving much-needed pre and post-strike photography and intel.

Back at the start of the F-15 programme, a degree of latent air-to-ground capability was installed in the basic airframe – indeed such systems would later be used by the Israeli Air Force at the start of the Eagle's combat career, but in USAF use, not so.

Throughout 1975 and 1976 the Eagle's air-to-surface potential was going to be realised before official service entry, but instead two things contrived to see the air-to-ground portion of training removed. The first was issues with certain weapons capability during trials – although a number of sorties were made with the F-15A/B in air-to-air fit but with Mk.82 dumb bombs. This was a fit considered the 'norm' for F-4 Phantoms in Vietnam. F-15s were eventually cleared for air-to-ground Mk.82 delivery up to 700 knots from 0.5 to 7.33G with up to 15,000lb of ordnance under the wings. Reports from the time say that the F-15A and B models would be on a par – accuracy wise – with anything currently in the USAF inventory.

Issues with weapons compatibility have been overcome. Although it was thought that software issues were the biggest problems – shades of today's F-35 Lightning II programme – there was another even bigger factor at work: pilot shortage. During late 1975 concerns began to be raised about the length of time it was taking to train pilots to fill slots in the F-15's new squadrons. It was therefore decided that from early 1976 the air-to-ground sections of the flight training schedule would be deleted, meaning that the F-15 would be the first USAF fighter since the end of the Second World War without a secondary surface attack role. Things would change…

LEFT: The unique wing planform of the F-16XL (E/F) conferred good fuel and weapons load. It still lost out to the F-15E.

By the early 1980s things had moved on and an aircraft called the 'Enhanced Tactical Fighter' was needed. The Eagle and Falcon stepped up...

F-15 FACTS

The last F-15 for the USAF was contracted way back in 2001. It's now possible that will change...

BELOW: At the heart of the F-15E's original avionics suite was the LANTIRN two-pod navigation and targeting system.

ENTER THE STRIKE EAGLE

By the end of the 1970s it was almost an ultimate irony that USAF planners were looking once more to 'multirole' aircraft, especially in the ground-attack role.

Even by the mid-1970s, on introduction to service the General Dynamics F-16 Fighting Falcon had shown its mettle in bombing competitions across the world and shown itself to be a peerless air combat fighter. In effect, aircraft like these could fight their way into a target, bomb and then get the hell out again. Other USAF aircraft such as the Vought A-7 Corsair and General Dynamics F-111 generally needed escorts, while aircraft languishing in the Air National Guard such as the beloved F-105 Thunderchief had shown themselves to need escort fighters when laden with bombs. As technology increased, so did accuracy and more could be done with a smaller bombload, which could be carried by smaller fighter-bombers. If the F-16 could be made into a useful attack aircraft, surely the F-15 could do even better?

The USAF began to look into a number of studies to see what form a future strike aircraft would look like. In 1978 the USAF began the 'Tactical All-Weather Requirement Study' (TAWRS) which looked at the possibility of buying more F-111s, with some upgrades or looking at advanced versions of existing airframes – including any multirole tasked F-15. By 1981 this had become the 'Enhanced Tactical Fighter' programme (ETF) which ostensibly would replace the large F-111 in the long-range tactical-strike, low-level, bad-weather interdictor role.

From these early studies, two aircraft

would come forward and battle it out to win the contract: General Dynamics F-16F/XL Fighting Falcon and the McDonnell Douglas F-15E Strike Eagle, the briefly considered Panavia Tornado for the USAF really was a non-starter.

The F-16E/F was based on the 'cranked-arrow' winged basic F-16, but the new wing gave the Falcon much higher internal fuel and more weapons stations. The F-15 Strike Eagle would be based on the F-15B/D two-seat airframe, with extra fuel carried on what previously were known as 'FAST' packs (Fuel And Sensor Tactical) but were by now – in effect – simply CFTs or Conformal Fuel Tanks. These would hug the side of each intake trunk, adding 2800 litres or 750 gallons of fuel, while simultaneously carrying six weapons pylons. This CFT system produced much less drag than using normal drop tanks – even if the CFTs could not be jettisoned.

By the late 1970s McDD had plenty of knowledge in the design of strike/attack multirole aircraft with its work on the navalised F-17 Cobra – called the F/A-18 Hornet. This was also a machine intended to fight its way to a target, destroy it and get home again on its own. The USAF wanted an aircraft that didn't need other escort fighters and that had powerful radar and avionics so it could find the target at night and in any weather, destroy it and have self-defence systems to avoid surface to air missiles and anti-aircraft guns.

The F-111 of the time (mid-1980s) had matured into a potent warplane, was blooded in the Vietnam War (if a little unsuccessfully) and was a true 'Cold War warrior', being based in the UK to oppose any Soviet threat. By the time the F-111F had entered service, with its AN/AVQ Pave Tack laser-designator pod, taking part in April 1986's 'El Dorado Canyon' mission against Libya, the Aardvark had a true precision attack capability and – with its variable geometry, highly-loaded wings – gave the side-by-side crew of two a very smooth ride at low-level, the only altitude at which attacks were considered to be made successfully in the 1980s.

However accurate the F-111 was with weapons delivery, it needed support in the form of 'Spark Vark' EF-111 electronic countermeasure aircraft and escorting fighters: because while it was very fast 'on the deck' the General Dynamics machine was no dogfighter, having only a limited armament. Early F-111s could carry a removable 20mm M-61 Vulcan cannon and had provision for AIM-7 Sparrow radar-guided missiles – but this was never used operationally. Instead the ubiquitous AIM-9 Sidewinder was the self-defence weapon of choice.

With the prospect of replacing/augmenting the F-111 in the late 1980s – not to mention the thought of replacing multirole configured F-4Es in USAF service alone, as well as the potential for export – McDonnell Douglas and Hughes (later Raytheon), looked into the use of a twin-seat F-15 tailored to complete the long-range strike/interdictor mission, but while keeping all of the F-15's impressive air-to-air power. This would initially be a privately-funded programme, and the airframe that would be used for development would be the hard-working second F-15B: 71-0291. It would be a test-bed for some ideas whereby the cockpit especially would receive some serious updates to help reduce the two crew's workload.

While the competing F-16XL was considered in both single (E) and two-

F-15 FACTS

The Strike Eagle was designed to be as adept at hitting a ground target as going air-to-air.

BELOW: The pilot's station had a new, wide-angle HUD, while the WSO's position was dominated by multi-function displays.

BELOW: A two-seat crew splits the workload in the F-15E although the WSO does have some flight controls.

> ***"The Strike Eagle would be a two-seater, with a pilot and a dedicated back-seater, who would employ weapons to engage ground targets."***

ABOVE: ***The definitive F-15E Strike Eagles had a common engine bay for both F-110 and F-100 engines and a longer flight hour service life.***

seat (F) versions, the Strike Eagle was always going to be a two-seater in its early, non-export form. In the back would be a 'Whizzo' or Weapons Systems Officer, also known as the 'pitter' (as in 'in the pit'!)

Hughes went to work on developing the existing AN/APG-63 radar, creating the multi-mode AN/APG-70, synthetic-aperture radar. This measures and uses the Doppler shift, which is created when the radar waves hit an object or the ground and are reflected back up to the antenna. The computer then uses this information to create either a two or three dimensional image of the landscape, including targets such as bridges, airfields and roads which could be scanned and seen in cockpit displays from around 100 miles away. As the range decreases the crew in the cockpit can then make out individual targets such as tanks, trucks and parked aircraft.

To aid in the 'stealth' of the attack-configured Eagle, the power of the AN/APG-70 lies in its ability to do a quick scan of the target area and then shut down, while the image of the target itself is still available to the crew. Important, considering the 'swing' role of the aircraft – where it needs to move between air-to-air and air-to-ground in an instant. The radar not only allows the crew to detect ground targets at long range, but the 'freeze-frame' of ground targets then allows the crew to go back into air-to-air mode, leaving the pilot to scan for those threats while the WSO targets ground threats.

Aiding targeting was (initially) the Pave Tack pod, similar to that used on the F-111F in its bomb bay. In fact the company demonstrator used this when it went to Farnborough in 1980. This was soon replaced by the more elegant twin-pod Martin Marietta (now Lockheed Martin) LANTIRN or Low Altitude Navigation and Targeting Infra-Red for Night pods. This used the AN/AAQ-13 navigation pod (hooked on the right forward intake trunk of the F-15) and the AN/AAQ-14 targeting pod on the left intake trunk.

Information from the pods could be shown on one of the large, multi-function screens in the F-15's cockpit (three in the front – two of which were monochrome and one colour: four in the rear, two of which were colour) while the FLIR images (Forward Looking Infra-Red) allows high-quality 'daylight' imagery to be projected onto the F-15E's wide field of view (WFOV) Kaiser Head Up Display. This could also be seen in the rear seat by the WSO as a 'HUD repeater' so he sees what the pilot sees.

The WSO uses the screens to glean information from – not just the radar – and also to check the electronic warfare equipment and defence systems. It also helps them to get the best out of the various air-to-ground and targeting systems and has two control sticks with which to manage the workload.

The displays can be swapped from one screen to another (often a matter of preference from one Whizzo to another) and the back-seater also has a limited set of flight controls, in addition to the two side-control sticks. This includes throttle (no HOTAS or Hands-On Throttle And Stick controls) a joystick, rudder pedals, compass and other basic instruments, including dropping the landing gear. It's rumoured that more than one WSO has taken control of an F-15E when they thought the pilot had succumbed to G-LOC or G-induced Loss Of Consciousness...

The LANTIRN system itself can be linked to the aircraft's FCS (Flight Control System) to allow low-level terrain following 'hands-off' at night and in all weathers. The development of both pods was lengthy, beginning in 1980 and ending in 1987 when the first pod was delivered to the USAF – long after the F-15E had been chosen as the winner of the competition.

Airframe development was ahead of that of the targeting pods, but many changes had led to the Strike Eagle being heavier even as a basic airframe, with associated strengthening of the airframe, landing gear and emergency arrestor hook as a result. McDonnell Douglas gave ➤

***ABOVE:** One of the first production machines destined for RAF Lakenheath.*

the E-model a 16,000-hour fatigue life (around twice that of the original F-15A) and the avionics and engine bays were re-designed – partially as a nod to future use of the General Electric F-110 engine. This part of the aft fuselage utilised advanced engine bay structures made from 'Superplastic Forming and Diffusion Bonding' tech. This is where metal sheets are welded together at their very edges, heated in a female mould and then an inert gas is injected between the sheets to fit the mould itself. This system helps make complex structures that are very strong.

Also internally, ammo carriage space for the internal General Electric M-61 A1 Vulcan cannon was reduced, so the number of rounds went down to 500 rounds in the Strike Eagle from 940 rounds in the F-15C.

The new F-15E benefitted not only in improvements to the radar, but Pratt & Whitney had also used the updated F-100-PW-220 from the F-15C/D as the initial engine of choice for the early F-15Es, before the more powerful F-100-PW-229

From service entry in the late 1980s, the Strike Eagle has undergone a number of updates both to systems and weapons to keep it viable over the modern battlefield."

motor (29,000lb thrust, so up by 20%) came on stream in the early 1990s. There was a chance that the General Electric F-110 was to be used – thanks in part to those engine bay changes for installation/plumbing commonality – but all USAF F-15E Strike Eagles would be Pratt & Whitney powered, while later Strike Eagle variants for export would use GE's F-110.

STRIKE EAGLE WINS THE COMPETITION

During the early 1980s the two main protagonists were evaluated. From 1981 until the end of April 1983, the F-15E Strike Eagle demonstrator went up against the F-16XL/E/F. During this evaluation phase, the four F-15E demonstrators made around 200 flights, with a wide variety of the then in-service USAF weapons in 16 differing configurations, with take-off weights of more than 75,000lb. To compare, the F-15C has an empty weight of 28,000lb, loaded weight of 44,500lb and a maximum take-off weight of around 68,000lb. On entry into service the empty weight of an F-15E Strike Eagle would be around 31,700lb with an MTO of an impressive 81,000lb, but still somewhat shy of the F-111F's 100,000lb!

While the interesting F-16XL was clearly a remarkable aircraft a number of factors led to the announcement in February 1984 that the F-15E Strike Eagle was the winner. Those factors included the perceived (if not proven) twin engine safety, future growth potential and lower development costs thanks to using the already proven (if somewhat modified) basic F-15 airframe. The USAF would eventually look to buy 392 of the new Strike Eagle, with the first being built in 1985 and 86-0183 making the type's first flight in July of that year. USAF

Going on the offensive defensively meant that the F-15E would utilise the basic airframe's agility and the improved (and more reliable) power from the Pratt & Whitney F-100-220 engines. Initially late L/M versions of the AIM-9 Sidewinder were the trademark self-defence missiles until the widespread introduction of the AMRAAM (Advanced Medium Range Air-to-Air Missile). It was thought that the air-to-air capabilities of the F-15E Strike Eagle were at the very least a match for the F-15C MSIP (Multi-Stage Improvement Programme) updated fighter Eagle and – thanks to increased thrust – the aircraft would have extremely similar

F-15 FACTS

Strike Eagles had all the air-to-air capabilities of the F-15C MSIP/ Improved USAF Eagles.

A Strike Eagle crew, down low, eject flares in self-defence.

F-15E Strike Eagles break for the camera.

> *"While the Strike Eagle may not have had the ultimate range of the F-111 or the ride at low-level, it was at least as accurate and could tangle with enemy fighters."*

performance characteristics, so that means prolonged high-G agility and a maximum of 9G positive and a thrust to weight ratio of around 0.93 at best. By comparison, the F-111 had (at best) a meagre 0.61 thrust to weight ratio from the TF-30 engines.

Oh and the F-15E had a second set of eyes in the back seat, operating out of a blown canopy too, to call out the bogeys on their six o-clock.

For the low-level role in which it was originally envisaged, the F-15E was a different animal to the F-111 it was looking to complement and later replace.

The F-111 had something of a 'magic carpet ride' down on the deck, thanks to its high wing loading: this is the amount of weight per square area of wing. The higher this is, generally the smoother the ride is and more 'buffet free'. With wings spread forward, the Aardvark had a 126lb per square foot wing loading (615.2 kilo per square metre) while with the wings fully swept, this rose to 158lb per square foot (771kg per metre square).

In comparison the Strike Eagle's wing loading was 112lb per square foot (or 546 kilos per square metre) and interestingly the old F-4E's sat at around the 78lb per square foot (380 kilos per metre square). For the F-15E, this meant that the ride wasn't quite as plush down low, and – with the wing being designed from the outset for fighter-like agility – it suffered as a result.

But there was no questioning which machine was more accurate – F-4E, F-111F or F-15E Strike Eagle. In June 1990 – just months before the Strike Eagle would go to war – the USAF held a gunnery meet at Davis-Monthan air force base and the new Strike Eagle beat the old-hands from the service to take the top two spots. Things would improve still further as pilots got to learn more from their aircraft and its systems.

FURTHER UPGRADES

Following its combat introduction in Desert Storm, the Strike Eagle community has been at the tip of the spear when it comes to deployment to any hot spot around the world.

As a result the capabilities of the base airframe have been constantly improved thanks to new avionics, engine upgrades and the like. Some updates have come via lessons learned on export orders of the F-15E – or simply via necessary upgrades to keep the USAF's own fleet relevant and up-to-date.

The field of radar technology has come on in leaps and bounds over the last 30 years since the original introduction of the F-15E Strike Eagle and its Hughes/Raytheon AN/APG-70 system. Originally called AN/APG-63/(V4) until 2009, the AN/APG-82 (V1) is a brilliant 'parts bin special', combining the processor of the AN/APG-79 used on Boeing's F/A-18E/F Super Hornet

As well as internal upgrades to radar, engines and systems, updates to the podded sensor suite and modern weapons will see the F-15E at the sharp end for decades to come.

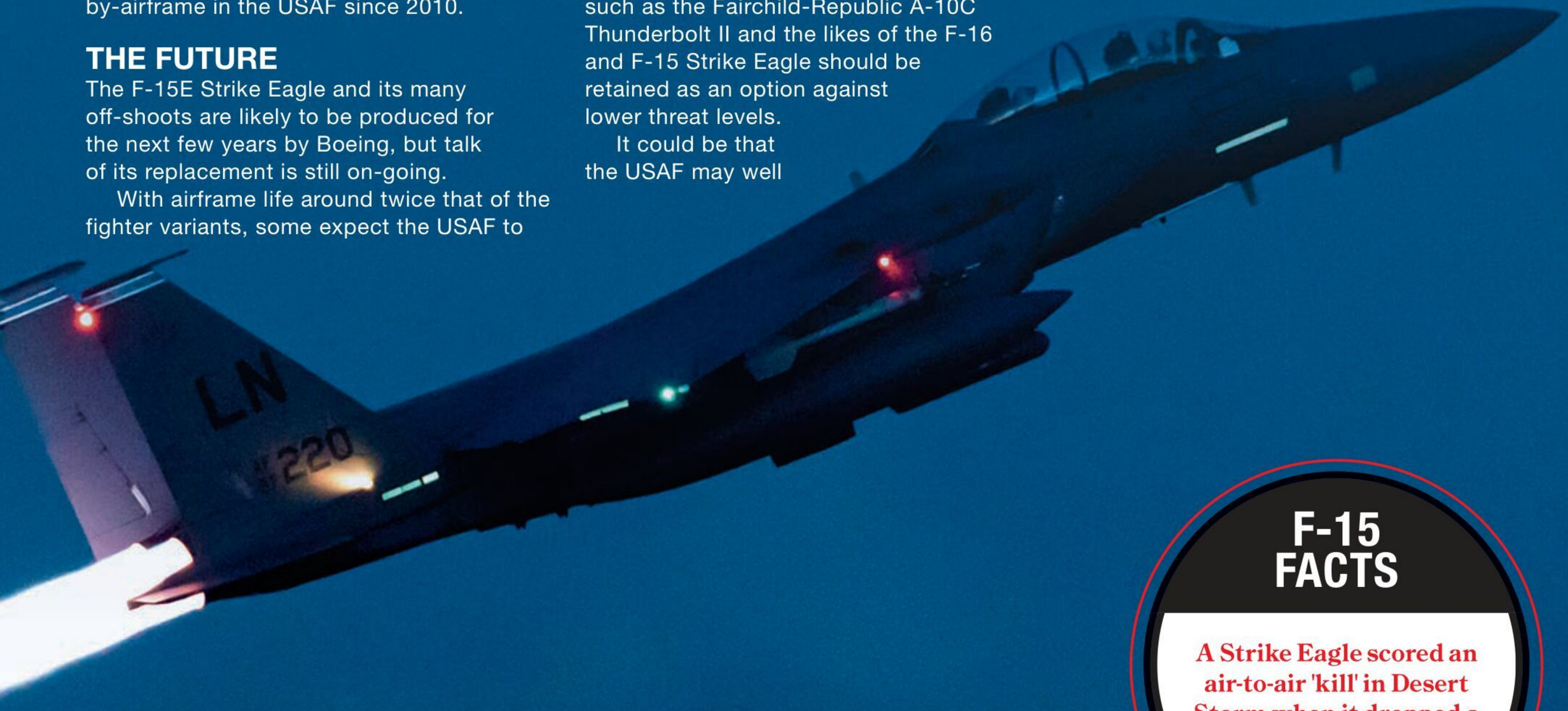
with the AN/APG-63 (V3) AESA (Active Electronically Scanned Array) antenna from the F-15C fighter. Along with other upgrades including cooling and resistance to electronic warfare jamming, the new radar has been introduced fleet-wide, airframe-by-airframe in the USAF since 2010.

THE FUTURE

The F-15E Strike Eagle and its many off-shoots are likely to be produced for the next few years by Boeing, but talk of its replacement is still on-going.

With airframe life around twice that of the fighter variants, some expect the USAF to retain the F-15E until around 2040. Future options for replacement could mean more 5th generation jets such as the Lockheed Martin F-35 Lightning II and yet – despite the amazing synthesis of systems in that aircraft – many believe that some platforms such as the Fairchild-Republic A-10C Thunderbolt II and the likes of the F-16 and F-15 Strike Eagle should be retained as an option against lower threat levels.

It could be that the USAF may well turn to the well-proven Boeing F-15E Strike Eagle again as a stopgap and supplement to incoming 5th gen aircraft, pending the design and development of any new 6th generation platform.



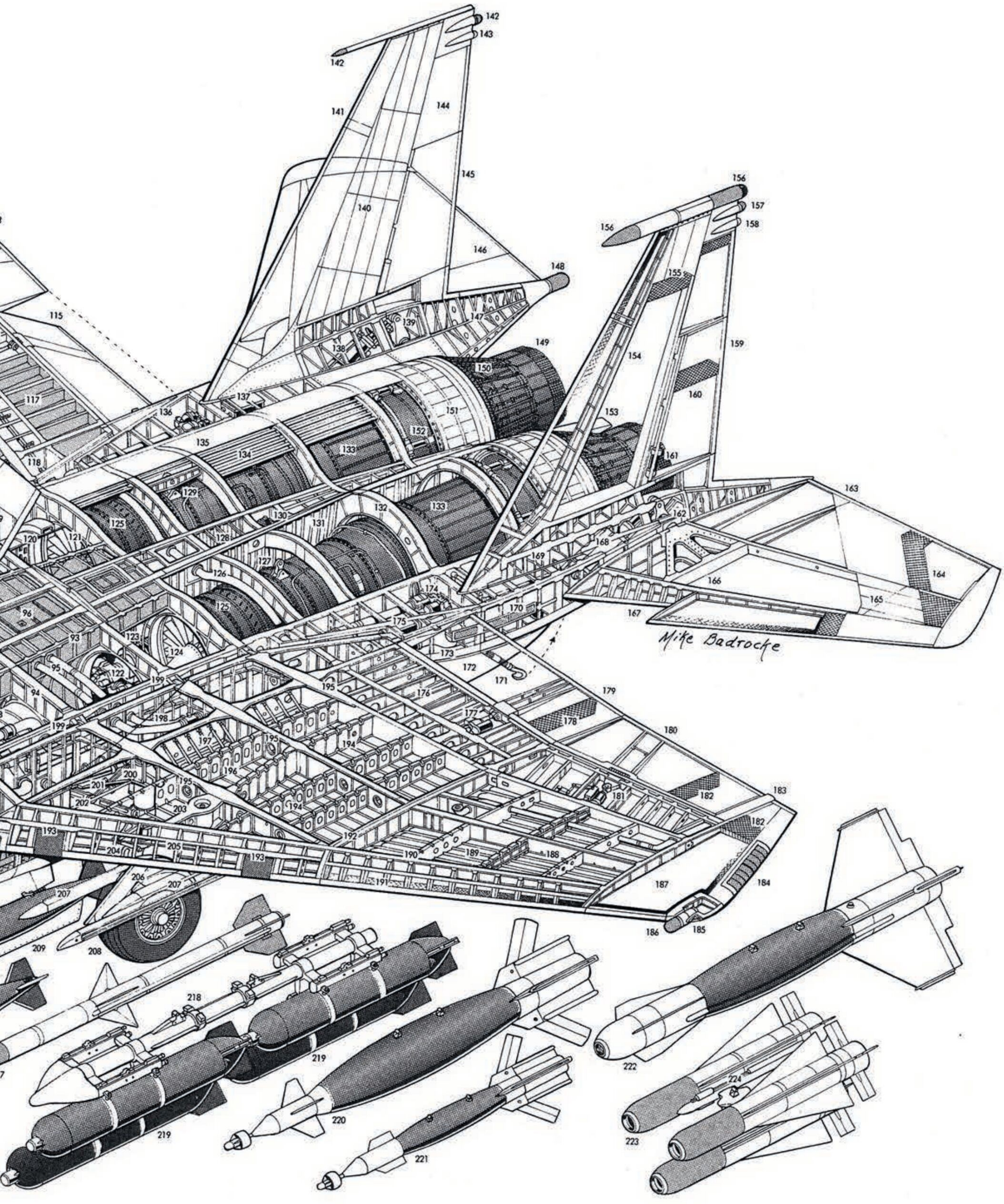
With its array of sensors, the F-15E is one of the most effective night attack aircraft.

F-15 FACTS

A Strike Eagle scored an air-to-air 'kill' in Desert Storm when it dropped a bomb on a hovering Iraqi helicopter.

MCDONNELL DOUGLAS F-15E EAGLE

1. Glassfibre radome
2. Hughes APG-70 pulse-doppler radar scanner
3. Scanner tracking mechanism
4. Radome hinge
5. Wide band radar 'flood horn'
6. Scanner mounting
7. Radome bulkhead
8. ADF sense aerial
9. Avionics equipment bay, port and starboard
10. APG-70 multi-mode system equipment
11. UHF aerial
12. Pitot head
13. TACAN aerial
14. Cockpit front pressure bulkhead
15. Angle of attack transmitter
16. Electro-luminescent formation lighting strip
17. Rudder pedals
18. Control column
19. Instrument/display panel shroud
20. Windscreen demisting air duct windscreen panel
21. Single piece frameless windscreen panel
22. Pilot's wide field head-up display (HUD)
23. Cockpit canopy cover, upward hinging
24. Starboard side console panel
25. Pilot's McDonnell Douglas ACES II 'zero-zero' ejection seat
26. Cockpit coaming
27. Engine throttle levers
28. Port side console panel
29. Underfloor avionics equipment bay
30. Retractable boarding ladder
31. Nosewheel leg door
32. Shock absorber leg strut
33. Landing/taxying lamps
34. Retraction/breaker strut
35. Nosewheel leg door
36. Built-in test equipment panel (BITE)
37. Underfloor control runs
38. Boarding steps/handgrips
39. Flight control augmentation system equipment
40. Canopy emergency release
41. Rear cockpit engine throttles
42. Radar hand controller
43. Rear instrument/display console
44. Starboard intake external compression lip
45. Intake negative incidence position
46. Canopy centre arch
47. Boundary layer bleed air spill duct
48. Ejection seat headrest
49. Seat safety handle/arming lever
50. Weapons Systems Officer's ACE II ejection seat
51. Cockpit pressurisation valves
52. Rear pressure bulkhead
53. Canopy jack
54. Port engine air intake box construction
55. Variable capture area 'nodding' air intake
56. Intake high incidence position
57. 507 Imperial gallon (610 US gallon, 2309 litre) external fuel tank centreline pylon mounted
58. Intake pivot fixing
59. Conformal fuel tank forward fairing
60. Fuselage/wing panel sponson fairing
61. Intake fuct variable area ramp doors
62. Intake incidence control jack
63. Cockpit air conditioning plant
64. Canopy hinge point
65. Air conditioning system cooling air exit louvres
66. Forward fuselage fuel tanks: total internal capacity 1681 Imperial gallons (2019 US gallons, 7643 litres)
67. Intake ramp hydraulic jack
68. Bypass air spill duct, open
69. Bypass door jack
70. Bleed air louvres
71. Refuelling receptacle door actuator
72. Port conformal fuel tank, capacity 624 Imperial gallons (750 US gallons, 2839 litres) each port and starboard
73. Conformal tank tangential weapons pylons
74. Ventral main undercarriage wheel bay
75. Port anti-collision light
76. Boom-type air refuelling receptacle, open
77. Bleed air supply duct to air conditioning plant
78. Intake ducting
79. Air refuelling feed pipe
80. AN/ALQ-135 ECM system equipment bay
81. Ammunition magazine, 940 rounds
82. Airbrake hinge point
83. Upper UHF aerial
84. Starboard intake bleed air spill door
85. Cannon muzzle aperture
86. Cannon barrels
87. Starboard anti-collision light
88. M61A-1 Vulcan 20mm cannon
89. Hydraulic rotary cannon drive unit
90. Ammunition feed chute
91. Dorsal airbrake, open
92. Airbrake hydraulic jack
93. Centre-fuselage fuel tanks
94. Machined fuselage main bulkheads
95. Wing/fuselage fuel tank interconnections
96. Fuel tank access panel
97. Airbrake honeycomb core construction
98. Starboard wing integral fuel tank
99. Leading edge integral fuel tank
100. Starboard wing stores pylon
101. Missile launch rails
102. HF flush aerial panels
103. Wing pylon attachment fitting
104. Fuel system piping to wing pylon
105. Fuel vent box
106. Outer wing panel dry bay
107. Cambered leading edge panel
108. Forward ECM transmitting antennae
109. Starboard navigation light
110. Wing tip fairing
111. Electro-luminescent formation lighting panel
112. Fuel jettison pipe
113. Starboard aileron
114. Aileron hydraulic actuator
115. Starboard plain flap, down position
116. Flap hydraulic actuator
117. Trailing edge box integral fuel tank
118. Aileron control run
119. Hydraulically-driven emergency generator
120. Cooling system intake/bleed air spill duct
121. Intake compressor face
122. Airframe mounted engine accessory equipment gearbox
123. Jet fuel starter (JFS)/auxiliary power unit (APU)
124. Conical intake centrebody
125. Pratt & Whitney F100-PW-220 afterburning turbofan engine (General Electric F110 alternative fit)
126. Engine bleed air ducting
127. Forward engine support link
128. All-titanium rear fuselage/engine bay construction
129. Forward engine mounting
130. Fire extinguisher bottle
131. Engine bay dividing firewall
132. Main engine mounting 'spectacle' frame
133. Afterburner ducting
134. Corrugated inner skin doubler
135. Titanium skin panelling
136. Starboard air system equipment bay
137. AN/ALQ 135 system amplifier
138. Starboard tailplane hydraulic actuator
139. Tailplane hinge arm
140. Boron fibre fin skin panelling
141. Fin leading edge, titanium
142. Starboard fin tip ECM aerials
143. Anti-collision light
144. Fixed portion of trailing edge
145. Starboard rudder
146. Starboard tailplane
147. Tailboom fairing construction
148. Aft ECM transmitting antenna
149. Variable area afterburner exit nozzle
150. Nozzle actuating linkages
151. Nozzle shroud fairing
152. Fueldraulic afterburner nozzle actuators
153. Jet pipe central tail fairing
154. Fin spar construction
155. Boron fibre skin/honeycomb core construction
156. Radar warning antennae
157. Port rear ECM aerial
158. Tail navigation light
159. Port rudder
160. Rudder honeycomb core construction
161. Rudder hydraulic rotary actuator
162. Tailplane pivot fixing
163. Port all-moving tailplane
164. Tailplane honeycomb core construction
165. Boron fibre skin panelling
166. Tailplane spars
167. Leading-edge dog tooth
168. Port tailplane hydraulic actuator
169. Fin support structure
170. Electro-luminescent formation lighting strip
171. Retractable runway emergency arrester hook
172. Conformal fuel tank tail fairing
173. Ventral air system exhaust duct
174. Port air system equipment bay
175. Engine bleed air primary heat exchanger
176. Port wing trailing-edge box integral fuel tank
177. Flap hydraulic actuator
178. Flap honeycomb core construction
179. Port plain flap
180. Port aileron
181. Aileron hydraulic actuator
182. Honeycomb core construction
183. Fuel jettison pipe
184. Port electro luminescent formation lighting panel
185. Port navigation light
186. Forward ECM antenna
187. Port wing-tip fairing
188. Outer wing panel rib construction
189. Machined wing skin/stringer panels
190. Front spar
191. Cambered leading-edge ribs
192. Wing fuel tank outboard sealing rib
193. HF flush aerial panels
194. Machined wing ribs
195. Titanium wing spars
196. Port wing integral fuel tank
197. Wing root rib support struts
198. Fuel system piping
199. Wing spar/fuselage attachment pin joints
200. Main undercarriage leg pivot fixing
201. Hydraulic retraction jack
202. Forward breaker strut
203. Port wing pylon attachment hardpoint
204. Torque scissor links
205. Port leading-edge integral fuel tank
206. Port wing stores pylon
207. Missile launch rails
208. Port mainwheel, forward retracting
209. Mainwheel door
210. Mk 82 500lb (227kg) HE bombs (26)
211. Low Altitude Navigation and Targeting Infra-red for Night system (LANTIRN) targeting pod
212. LANTIRN navigation pod, starboard side
213. Litton forward-looking intrared (FLIR) aperture
214. Texas Instruments terrain-following radar
215. Mk 84 2000lb (908kg) HE bomb (seven)
216. Mk 83 1000lb (454kg) HE bomb (15)
217. AIM-120 Advanced medium range air-to-air missile (AMRAAM) (six)
218. Multiple ejector rack
219. Mk 20 Rockeye cluster bombs (26)
220. GBU-10 Paveway II 2000lb (908kg) laser-guided bomb (seven)
221. GBU-12 Paveway II 500lb (454kg) laser-guided bomb (15)
222. GBU-15 (V) 2000lb (908kg) cruciform wing weapon (CWW) (seven)
223. AGM 65 Maverick air-to-surface missiles (six)
224. Triple launch rail unit



Mike Badrocke

EAGLE: AI

No other aircraft has such an unrivalled record in the arena of air-to-air combat as the fighter versions of the F-15. The stats: anything up to 107 kills for zero losses. And – once more – it was the Israelis that led the way...

Many individual airframes have amassed impressive scores.

F-15 FACTS

Israeli F-15s have been in constant action since 1979 through to the present day.

R-TO-AIR

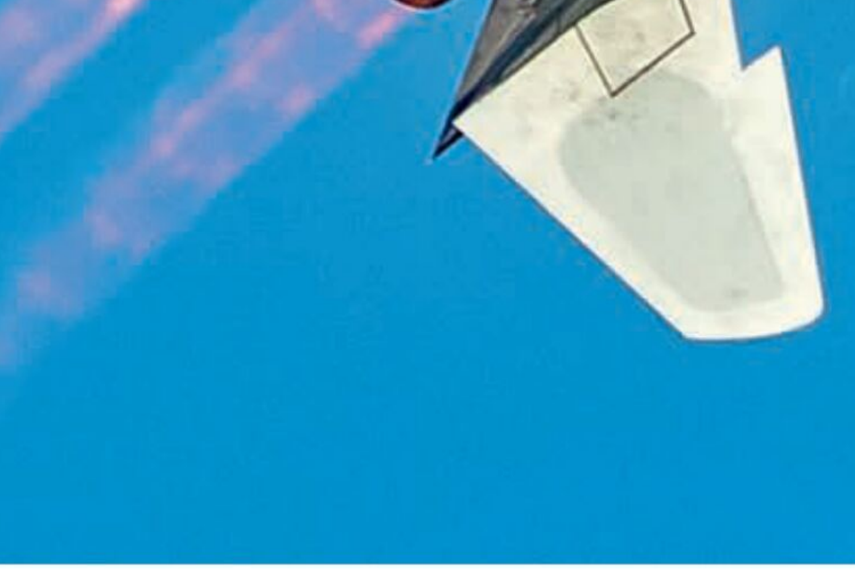
Power, performance, and the latest avionics made the Baz a force to be reckoned with in IAF service.

ABOVE: ***The Baz/Eagle has been in service with the IAF for more than 40 years.***

The first kills by the F-15 Eagle came on June 27, 1979, over Lebanon.

Four F-15 Baz aircraft from 133 Squadron, known as 'The Knights of the Twin Tail' or 'Double Tail Squadron' were on patrol to defend an air-strike on PLO targets along the coast between Sidon and Damaur. The squadron itself was set up in late 1976 to receive the new fighter (hence its name) and by 1978 the squadron was at full strength and had already flown missions over Lebanon.

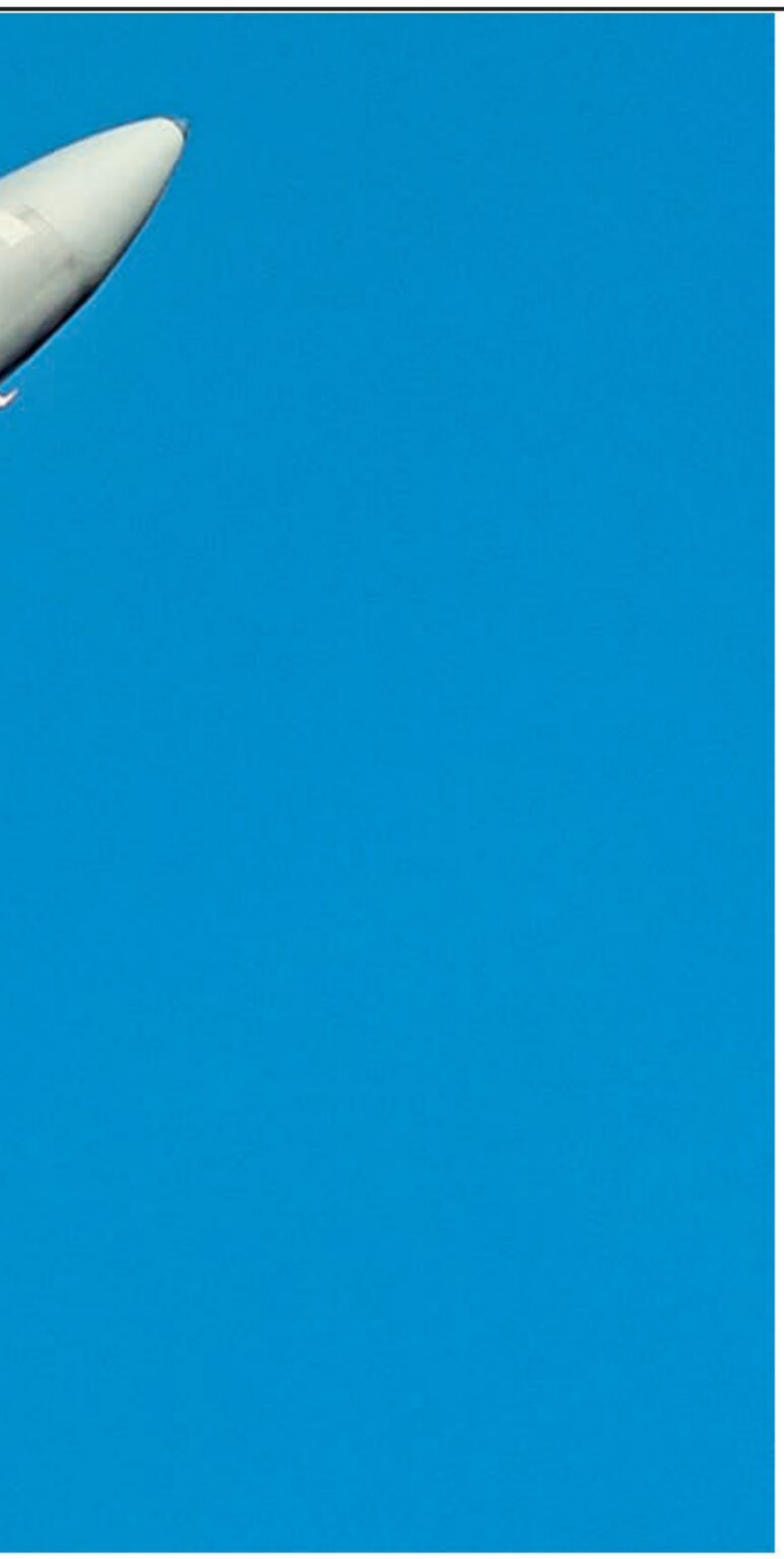
The four-ship on this day was led by Benny Zinker – the squadron's new commanding officer, with Major Moshe Melnik as his wingman (a highly experienced instructor pilot and five-kill F-4 ace), Eitan Ben-Eliyahu (future IDF/AF commander and former Double Tail CO, who was still flying with the unit) was number three with Yoel Feldsho, the squadron deputy commander, as his number two in the sole F-15B.



ABOVE: ***Moshe Melnik is second from left.***

Backing them up was a mixed force of more Eagle/Baz fighters and Israel's own indigenous Kfir, a Mirage-based delta multirole aircraft on CAP further back. This 'mixed Combat Air Patrol' was a shrewd use of resources by the Israelis. In previous wars tactics employed by the IAF included the more technologically superior fighter taking the lead in detecting targets and allowing other aircraft to take them down. It spread the experience of air-to-air fighting across the squadrons and was good for morale.

At around 11.10 hours the formation was informed by Israeli radar that three sections of MiG-21s had been detected, presumably reacting to the coastal raid. Radio jamming by the Israelis ensured that Syrian GCI (Ground Control Intercept) could not communicate with the MiGs. The F-15s then climbed from low-level, probably appearing on Syrian radar for the first time – but jamming ensured the MiGs again were



ABOVE: Eitan Ben-Eliyahu.

F-15 FACTS

Even today the IAF has a large force of F-15 Baz and Ra'am aircraft.

> ***"The Israelis showed the world how capable the F-15 was, with many victories in the 1970s and 1980s."***

not informed: they'd know soon enough…

Melnik takes up the story: "Benny opened up his afterburners, as did I, then we concentrated on our radar and got an immediate lock on the MiGs and we were quickly in launch parameters. They were around 20 miles or so away. Now we have permission from GCI to fire but usually we wait for the leader to give permission. I was wondering why Benny wasn't giving us the go ahead.

"I was waiting for him to tell me to shoot… It was then that I realised HE wants to be the first to make a kill. So I don't wait and I push the pickle button at the same tenth of a second as he does! Both AIM-7F missiles ride off and launch together in what looked like formation! It was a marvellous sight, seeing the missiles go off together. Then we waited and nothing happened."

Despite good conditions, both missiles failed to lock. "We were amazed and shocked," says Melnik. "So we went back to old habits – a good look outside, leaving the radar scope." The MiGs themselves had made a turn, before turning back towards the F-15s once more. Melnik: "They are making a reversal, turning right in front of us now from right to left. I get first tally on the MiGs (which makes him section leader now) and see they are MiG-21s so I select a Python 3 infra-red missile and launch it: I'm over-banked at more than 130 degrees. This time it scores a direct hit on the MiG-21 and there is no ejection."

With a second Syrian fighter looking to reverse onto Melnik's tail, thankfully he was being ably covered by Feldsho, who launched a radar-guided AIM-7F which destroyed the MiG-21 which was angling for Melnik.

Then a second formation of MiG-21s made itself known to the F-15 pilots, as well as the two remaining 21s. Eitan Ben-Eliyahu recalls: "The number four from the first formation came at me head-on and came past me, so it was one versus one. Once he passed by he had no other choice but to engage me and I had no other choice but to kill him."

The secondary CAP had also caught up with the main Baz four-ship, realising it was not worth risking long-range BVR (beyond visual range) Sparrow shots with their countrymen out front. Yoram Peled was leading this formation of F-15s and IAI Kfirs and was closing quickly into the fight. Peled would see Ben-Eliyahu's descending dogfight from above and spot two MiG-21s ahead of Eitan Ben-Eliyahu's Baz. Peled would drop the nose of his F-15, acquire a tone from his AIM-9G heat-seeking missile and destroy the trailing MiG that Ben-Eliyahu was originally aiming for.

Ben-Eliyahu's MiG-21 was turning as hard as it could, but could not match the F-15's sustained turn rate, thanks to a lack of excess thrust. Instead the Syrian would trade height for energy, and down the spiral both Eagle and MiG would go. "So after two and a half turns close to each other, he was looking for the right time to escape," says Ben-Eliyahu. "He had no other choice as we were close to the ground and he had to decide. The minute he rolled out I did another pull on the control column and I was right after him: around 600-650 yards. I switched to guns and squeezed the trigger twice: two shots and he was gone."

With the confusion of that dogfight back at base Ben-Eliyahu would ask: "Who smashed that MiG right in front of my face?" Peled would sheepishly admit that it was him and apologise, but all was forgiven as the IAF had not only taken four kills with their new F-15 Baz fighters, but done so with an AIM-7F, AIM-9G, Python 3 and 20mm cannon: all of the weaponry available to the Baz at the time, making this a gentlemen's set, if you will.

Melnik recalls: "Looking back now, my first flight in the F-15 was like my first solo in life… the excitement and joyfulness. It was just great. That day was a big achievement but we all looked enviously at Ben-Eliyahu's kill as it was with guns and we felt he was the hero of the day as we Israeli pilots favour guns kills!"

This was just the start of the Baz's domination of the skies above The Middle East. Yet more Syrian aircraft were downed on September 24, 1979: four more MiG-21s. 1981 saw two MiG-25 Foxbats brought down – one on February 13 by Benny Zinker – and one on July 29, both with AIM-7s. This was the first time the Eagle had clashed with the aircraft it was effectively designed to destroy and the one that the Israelis had purchased the Eagle to protect themselves against.

On June 7, 1981, the McDonnell Douglas F-15 supported Operation Opera/Babylon, Israel's attack on the Iraqi Osirak nuclear reactor, which was made by General Dynamics F-16s, with top cover provided by Eagles. The first MiG-23 kills came during The Lebanon War of June 1982. Also known as Operation Mole Cricket (and locally as 'The Bekaa Valley Turkey Shoot') actions between 7th to the 24th of June saw 33 MiG kills for the Baz force (including an Aérospatiale Gazelle helicopter) using a variety of missiles and cannon fire.

The victory was so complete, even Melnik said: "As far as our squadron was concerned, it was more like a shooting range." The latest recorded kills for the Baz F-15 fleet came in November 1985, while other 'desert Eagles' scored kills, with the Royal Saudi Air Force F-15Cs apparently destroying two Iranian Air Force F-4E Phantom IIs on June 5, 1984.

Since the first deliveries of the F-15A Baz, the improved C/D models were delivered in 1982-1983, while surplus

A/B models were delivered following Operation Desert Storm. Upgrades to the basic airframe and weapons (including air-to-ground, see the next chapter) meant that by the mid-late 1990s the IAF's Baz fleet was on a par with the USAF's F-15 MSIP (Multi-Stage Improvement Programme) airframes while the inclusion of the Elbit helmet-mounted sight, meant that the IAF's Baz fleet had a close-in, look-point-shoot capability 10 years before the USAF's F-15 Eagles, when integration of the JHMCS (Joint Helmet Mounted Cueing System) and the agile AIM-9X Sidewinder came on stream.

Other 'Baz 2000' additions were to give the Baz airframes a fleet-wide cockpit update (with new multi-function displays) improved radars to fire the AIM-120 AMRAAM, upgraded data-link systems, GPS navigation systems and myriad Israeli-sourced electronic warfare equipment. It is thought that more than 8000 man-hours per airframe went into the update.

Today Israel's F-15 Baz fleet is as important as it ever was, with the upgraded Eagles still involved in air-to-ground missions, despite delivery of the more modern F-15I Ra'am. Also, even with the introduction of the 5th generation Lockheed Martin F-35 Adir, fighter-bomber, it is considered important to integrate both the Baz and the Adir together, so both are ready to co-operate in any potential future air or ground battle.

With the Baz fleet enjoying more than 40 years in successful service of Israel, it would be interesting to see if – in four decades' time – the F-35 Adir (which means 'Mighty One') will be mighty enough to beat the F-15 Baz's total of 50 kills for no air-to-air losses.

"The F-15 Eagle has been at the cutting-edge of air-combat since 1979 and scored no losses."

THE F-15C IN DESERT STORM

With Israel's predicament of being surrounded by enemies in the mid-

Uprated F-15s still serve at the sharp-end of the IAF's fighter force. Note the 'R2-D2' satellite comms dome on this D-model.

1970s, it was understandable that they would be the first to blood the Eagle in air-to-air combat.

It would take the USAF's F-15 Eagle fleet some time before it made its first kill. Meanwhile, during the Cold War, the F-15's home-grown interceptor rival – the Grumman F-14 Tomcat – took part in two high-profile shootdowns of Libyan Sukhoi Su-22s in 1981 and MiG-23s in 1989. Adding to the Eagle drivers' frustrations would be rumours of the Tomcat's 160 kills during the Iran-Iraq war of 1980-1989, as well as the fact that the Iranians had an 11-kill double ace who flew the F-14 in the shape of Jalil Zandi. Hell, the F-14 was even the star of the blockbuster film TOP GUN while the Eagle was never given its own celluloid vehicle, but the F-15's turn would come and the USAF Eagle pilots would finally get their chance to score thanks to Iran's deadly enemy, Saddam Hussein's Iraq.

On August 2, 1990, Iraq invaded Kuwait, triggering Operation Desert Shield, which lasted until the following January when – on 17th of that month – combat was finally joined, with coalition air forces turning Desert Shield into Desert Storm… Finally the F-15 Eagle community would have the chance to prove themselves in battle.

The first F-15 kill of the war would be against the agile MiG-29 and be made by Jon 'JB' Kelk as callsign PENNZOIL 63. In the first few hours of Desert Storm and at night, he would take down his MiG in F-15C serial '85-119' using an AIM-7M Sparrow. Colonel Kelk would have a long association with the F-15, eventually finishing his flying career on March 12, 2009, when – after being the first pilot to accrue more than 4100 hours in the Eagle – he would 'suffer' the traditional dousing with a fire hose after his final flight with the Missouri Air National Guard, where he spent the final 17 years of his time with the Eagle. Five more Eagle kills would be made on January 17: two more MiG-29s and three French-built Mirage F-1EQs, including a double kill for Robert 'Cheese' Graeter.

Two days later, on January 19, 1991, four F-15Cs were on patrol above Western Iraq and these Eagle drivers were about to take on a deadly foe: the MiG-25 Foxbat, flown by combat-proven Iraqi pilots.

Rick 'Kluso' Tollini was number one in F-15C '85-099', with Larry 'Cherry' Pitts as his number two, in '85-101'. Pitts recalls: "As it turned out, just as we were finishing our refuelling the AWACs called out bogeys around 60-80 miles north of us. I saw two groups of aircraft, the one in front as MiG-25s at 10,000ft heading south and another 30 degrees right at 15 miles as MiG-29s heading south, south-west. We were escorting a strike package and I figured the 29s were the greater threat, but they turned around and went (what we call) 'cold' so were no longer a threat, so my radar work went back to the MiG-25s…"

As the range went down, Robert 'Cheese' Graeter locked on to one of the MiG-25s, but here was where the Iraqi pilots showed their mettle. At 25 miles and with Graeter 'locked-on' the MiG-25 pilots employed a Soviet anti-radar tactic: the Foxbat pilot started diving for the deck, to the west, while simultaneously dumping chaff to fool the Eagle's radar.

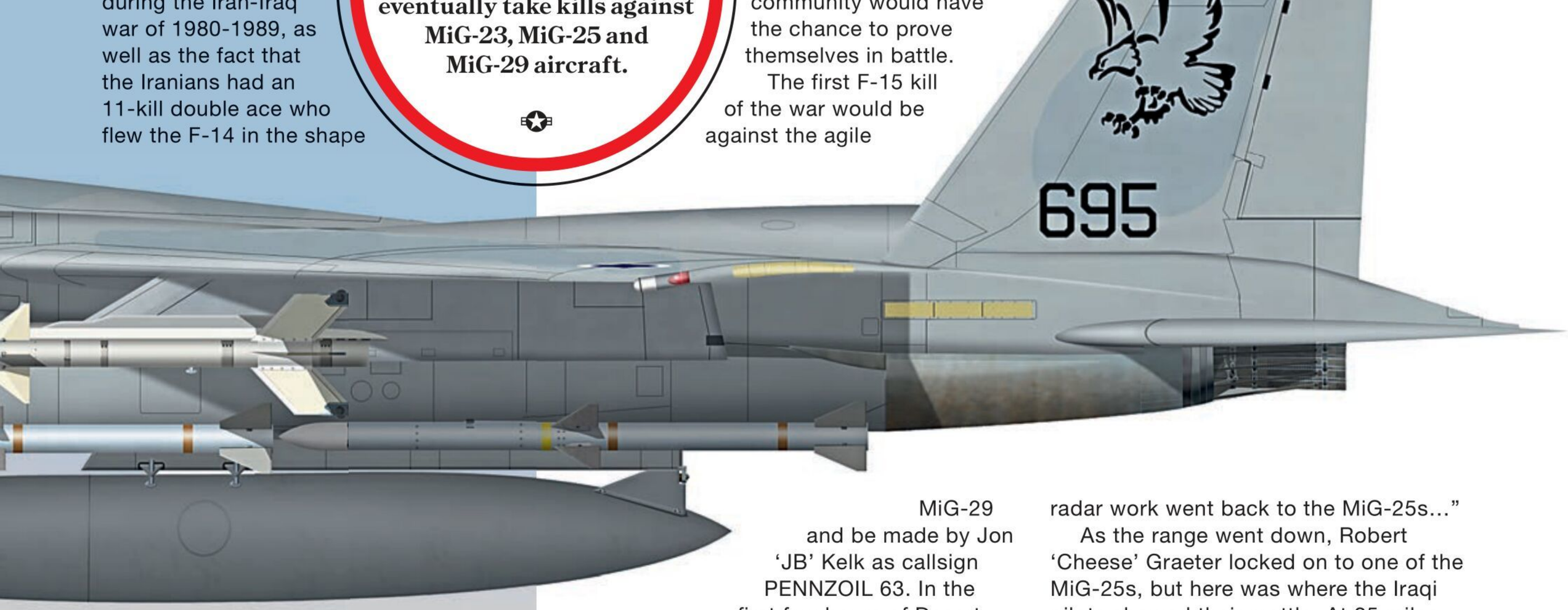
Pitts explains: "That was when we lost them for a while, but then they turn back in, hoping to see us first: that's when the second MiG gets my attention. I'm on the right side of the flight and he's passing across my nose at supersonic speed so I lock him up. Cheese says 'press', which means he's supporting me now and I'm flight lead, I go inverted and split S from 10,000ft to get down right behind the MiG. I pull around 12g on the airplane! I was concerned about the integrity of the plane but the Eagle is very strong and there was a lot of adrenalin flowing so it didn't even faze me. As I pulled down I can now 'tally-ho' the MiG-25, as I can see him on top of the cloud deck."

The only real way a MiG-25 in this situation could escape would be to light the afterburners and use the huge thrust available from the twin Turmansky R-15B-300 turbojets to try and extend away. The Foxbat has the power, but instead this MiG-25 pilot starts to turn. This is a bad move. "He's a MiG-25 doing 700 knots, so his turn radius is the size of Texas," explains Pitts. "I'm in an F-15C Eagle at fighting speed in the mid-400s and my turn radius is 3200ft. I'm quickly inside

F-15 FACTS

USAF F-15s would eventually take kills against MiG-23, MiG-25 and MiG-29 aircraft.

BELOW: ***An F-15C Baz from 133 Squadron, seen at Tel Nof in 2010, armed with AIM-120C AMRAAMs and Python 3 and 4 short-range AAMs.***



For many in the IAF the Baz – with its 50 kills – will be the ultimate air-to-air platform.

F-15 FACTS

Strike Eagle airframes have more hours on them than the original F-15A, B, C and Ds.

ABOVE: JB Kelk took the USAF's first kill of the war and is seen here on the event of his final F-15 flight in 2009. A number of USAF pilots would score kills and amass hours on the F-15 Eagle.

his turn and in weapons parameters. He's turning hard and bleeding airspeed, but I'm inside him and 9000ft away and seeing the 'burner plume I chose a Sidewinder, got a good tone, I check the seeker is on him and the missile tracks true but the MiG puts out flares and decoys the missile!"

What follows is almost a copy of numerous missile engagements from the Vietnam War. Pitts again: "I then selected an AIM-7 and see the circle saying 'SHOOT SHOOT' in the HUD, and the missile is launched, gets to the target but fails to explode. So I try a second AIM-9 and that's decoyed! This guy is fighting hard, I figured I may have to go and gun this guy, which isn't an easy thing to do as he's at 300ft doing 500 knots in a turn. Finally, I use my last AIM-7, fire it from 6000ft and it looks to go right up his tailpipe and he blows up." The pilot, Hussein Abdul Sattar, ejected but sadly didn't survive.

Pitts flies through the debris and sees Tollini high to his left. Then, around five miles off his nose Pitts sees a glint which he thinks is the other MiG-25, closing fast. The bogey looks like an F-15 from certain angles, so Tollini calls out 'is anyone in afterburner?' as there's the tell-tale plume. When he hears there is no F-15 in afterburner Tollini fires an AIM-9 and Pitts witnesses the action: "I see the missile going towards the MiG, but it's decoyed by flares also. These guys are fighting hard… but then he turns belly up: we can see his planform and that's not good. Rick then fires an AIM-7 and that airplane turns into a ball of dust." Splash two MiG-25 Foxbats.

> ***"So the MiG is fighting hard – I realised I may have to gun this guy: which isn't easy as he's at 300 feet and doing 500 knots in a turn..."***

On the same day, just 100 miles away it was a case of F-15 vs MiG-29 once more and Cesar 'Rico' Rodriguez and Craig 'Mole' Underhill were there. 'Rico' says: "Our mission was defensive counter air protecting tankers, AWACS, Rivet Joint anyone in support of the offensive missions…" Suddenly the mission changed, 'Mole' recalls: "We were now asked to cover the strike package on the way out from a target."

Up ahead the pair have contacts and IFF suggests these are MiG-29s: it's an unnerving situation, as Mole explains: "The thing we heard was that Iraq had taken its best Mirage F-1 pilots and put them in the much more agile MiG-29s, so they were combat proven and in a good jet." Both F-15s quickly locked-up the MiG-29s

BELOW: ***For many USAF pilots before 1991, this was as close as it got: an F-15C fires a Sparrow in training.***

ABOVE & BELOW: ***With twin tails, it was easy to see how the MiG-25 could be mistaken for the F-15 Eagle. Also pictured is a destroyed Iraqi MiG-29. The Fulcrum represented the cutting-edge of Iraqi equipment during Desert Storm.***

RIGHT: ***A kill mark showing Rick 'Kluso' Tollini's MiG-23 kill of January 28.***

which then turned east to avoid them, going 'cold' but just as this happened another pair of MiG-29s were coming in fast towards the F-15C pair from the west, on a heading of 330 just 13 miles away.

Rico says: "So, now we turn west to head off the threat. I'm a mile-and-a-half ahead of Mole and 1000ft below. Mole is now trying to get a lock and trying to get an ID before the merge…" Craig 'Mole' Underhill: "There are a lot of things you're doing with your left hand and you're

dialling the gauges and doing things so you're not going to shoot down a friendly." At eight miles AWACS call them as hostile. Mole again: "Literally, as soon as I hear that I'm firing an AIM-7. It comes off the rail like a freight train under my nose then starts to pull lead on that first aircraft."

Then things start to really happen: with the two F-15s and two MiG-29s charging straight at each other and with an AIM-7 Sparrow in the air, the second MiG-29 piloted by Captain Jameel Sayhood locks up 'Rico' Rodriguez who then has to take evasive action. He says: "I'm fully defensive and need to get below his plane of motion, which is 8000 feet, so his radar is looking at me and ground clutter. I pump out chaff also at the same time as I'm doing so."

The move means that Mole's Sparrow goes by Rico's F-15… and close. Mole:

"I'm watching my missile go in towards Rico: plus or minus 200-300ft over the top of his jet. That was eye opening…" For Rico it was more so: "I hear Mole call 'fox' and I see left, over my shoulder, the motor of his AIM-7 pass me by. I'm at the mercy of what that missile is going to do, but two to three seconds later… BOOM." Splash one MiG-29.

The other MiG-29 – piloted by Sayhood – decides to bug out. Meanwhile Rodriguez rejoins with Underhill. Rico says: "So, I climb up and rejoin Mole for mutual support and at this time I'm thinking we should just get the hell out of there."

As the pair are heading south for the tanker there comes another warning from AWACS: there's a second contact 10 miles north. Turning back into the fight, the Eagle pair pick him up with radar: 'Mole' Underhill is at 8000ft, the bogey is at 10,000ft and Rico is half a mile behind Mole. Mole says: "I lock him up with auto guns and he breaks back left in a hard G turn: this makes him a large radar reflective target for a Sparrow. So I try and lock him up and put my nose on him and shoot an AIM-7, but the reticule goes to a diamond which says he's a friendly. Now I'm wondering about my first shot and that's a terrible feeling. Did I previously kill a friendly? We in the Eagle community take fratricide very seriously."

Mole then has the bogey locked up with his F-15C's AN/APG-63/70 radar, even if IFF (Identification Friend or Foe) would not let him fire his radar-guided Sparrow. As both aircraft go into the merge and what could become a turning fight, Mole is ready to switch from AIM-7 to AIM-9 Sidewinder and then to guns, if need be. "He's breaking hard into me," recalls Mole, who then climbs to 9000ft above Rico, leaving his wingman to head into the merge and ID the bogey while Mole is ready to take a missile shot, should the unidentified aircraft prove to be hostile.

Rico says: "I'm looking at my target direction box to see if I can ID him before visual range so Mole can take a shot and get this over with. I'm going head-on with him. I was committed to the merge to get as close as possible for a visual ID. As he came past me, I could see the Iraqi colours on the tail fin and the MiG-29 silhouette just as we both start a left-hand turn."

The fight between Rico and Sayhood descends to the desert floor – around 600ft – which means it becomes a big factor in the battle itself. Rico tries to position himself for an AIM-9 Sidewinder shot, but then Sayhood tries to execute a Split-S move (a half roll, followed by an inverted half-loop, to lose height and change his direction of travel by 180 degrees).

The Iraqi pilot has insufficient altitude to complete the move and crashes to the desert floor. Splash two. Rico would be awarded a manoeuvring kill, but would be frustrated on the way back to base when he was continuously being 'locked up' by the AN/APG-63 of an RSAF F-15C, forcing him to threaten to destroy the offending aircraft if it happened again.

F-15 FACTS

The Eagle has taken medium-range, short-range and a close-in-gun kill during its service life.

RICO'S SECOND AND THIRD KILLS

January 26, 1991, saw a textbook example of BVR kills for the F-15 and Rico was involved once more. This time he was with Rhory 'Hoser' Draeger, Tony 'Kimo' Schiavi and Bruce 'Roto' Till and this four-ship was over Western Iraq once more, on CAP rotation, looking for trade over the H-2 Iraqi airfield, which was more than 200 miles west of Baghdad.

Tony 'Kimo' Schiavi recalls: "We hear that there are four guys taking off from H-2 and heading to the north east. So we go to work:

"From Israel, to the Gulf, to Bosnia, the F-15 was head and shoulders above the rest."

18+

WHAT IS AVAXHOME?

AVAXHOME-

the biggest Internet portal, providing you various content: brand new books, trending movies, fresh magazines, hot games, recent software, latest music releases.

Unlimited satisfaction one low price
Cheap constant access to piping hot media
Protect your downloadings from Big brother
Safer, than torrent-trackers

18 years of seamless operation and our users' satisfaction

All languages
Brand new content
One site

AVXLIVE.ICU

AvaxHome - Your End Place

We have everything for all of your needs. Just open https://avxlive.icu

F-15 FACTS

The highest scoring F-15 pilot in the USAF would have three kills.

ABOVE: ***Air-to-air refuelling has been called on to help get F-15 Eagles into the combat zone many times over the years.***

everyone has responsibilities now in the flight. Some guys are looking low, some looking high: we're covering anything from ground level to 50,000ft." The four move into line abreast formation, to give their radar maximum coverage ahead and pretty soon four contacts are seen. These clearly aren't friendlies and the contacts are made at long range. They have to be MiGs.

The four F-15Cs go to full military power to chase down their prey, Rhory 'Hoser' Draeger says: "We keep radars in sweep to know how many of them there are but we don't want a lock-on yet. If we do that too soon we would alert them. Suddenly we see one MiG return back to H-2 – so there are only three of them, in a vee formation. Soon they're confirmed as MiG-23s."

The Eagles are now cleared 'hot' to shoot. Draeger explains: "Our rules of engagement mean we can take action and we do. I assign targets, I have the lead, Kimo the lead's trailer and Rico has the southernmost guy. We're locked up and fire AIM-7 Sparrows." Soon, three huge explosions light up the sky with the F-15s coming through the clouds to see missiles hit the targets: this has been a textbook BVR mission and Special Forces later recovered the cockpit camera of one of the MiGs which had even recorded the moment of impact.

Cesar 'Rico' Rodriguez would later bag his third kill during Operation Allied Force in the Balkans. On the night of March 24, 1999, a MiG-29 flown by Major Iljo Arizanov was destroyed by a Raytheon AMRAAM fired from Rico's F-15C. This would put him level with two other USAF pilots on three kills – the highest for a US pilot since the Vietnam War.

AIR-SUPERIORITY ASSURED

Much has been made since The Gulf War about the complete saturation of the Iraqi air defences and the sheer number of Eagle kills versus those of other coalition aircraft. The lessons of air-superiority had been well learned.

The orchestration of pin-point attacks on command and control bunkers, airfields and the like would eventually paralyse the Iraqis, making them incapable of making their own co-ordinated air strikes or even putting up much more than a token defence. By the end of January more than 100 Iraqi Air Force front-line aircraft would flee to Iran, in a desperate bid to save the bulk of their modern fighter-bomber force.

What defence they did mount led to the destruction of 36 enemy aircraft by the F-15C community. Of the grand total itself, one kill was also awarded to an F-15E (a Hughes 500 Defender helicopter, destroyed with a GBU-10) an MBB Bo-105 chopper was destroyed by cannon fire from an A-10A Warthog, another A-10A would do the same to a Mil-8 Hip, two Chengdu J-7/F-7 Airguard/ Fishbed derivatives were taken down by McDonnell Douglas F/A-18 Hornets, while even the EF-111A 'Spark Vark' was credited with a manoeuvre kill on the first night of the air war.

And what of the F-14 Tomcat? One, pitiful kill… where an F-14A from VF-1 squadron took down a Mil-8 Hip with an AIM-9 Sidewinder. Almost embarrassing in comparison: so what gives?

The biggest reason seems to be that the lion's share of chances to take down enemy aircraft would obviously go to the air assets used for the major CAP areas, or TARCAP/ escort duties. Naturally this would be the domain of the Eagle. Other factors often mooted included the fact that AWACS would tend to look after their own when it came to trade and that US Navy fighters would generally escort their own strike packages which were in turn covered by generous USAF CAPs. Another suggested reason was that – with their experience with the F-14 Tomcat and AN/

LEFT: F-15 upgrades have included helmet-mounted sights.

BELOW: Japanese-based F-15s have been ready to support any call to arms in the Korean theatre of operations.

> *"Wherever they have been needed, F-15Cs and Es have been ready to answer the call."*

The shoot-down of a Lockheed Martin F-117A Nighthawk was a media coup for the Serbians.

EAGLE UNDEFEATED: FACT OR FICTION?

You're building and selling the greatest air-superiority fighter the world has ever seen, so it stands to reason you want to make it look good.

Call it PR spin or whatever, the figures seem to bear out the fact that the Boeing F-15 Eagle is the greatest air-to-air fighter ever built, with a kill ratio of 104:0. Yes, that's 104 kills for zero losses and that total could be as high as 107 kills. But have any F-15 Eagles been lost in air-to-air combat? Rumours are that some have been…

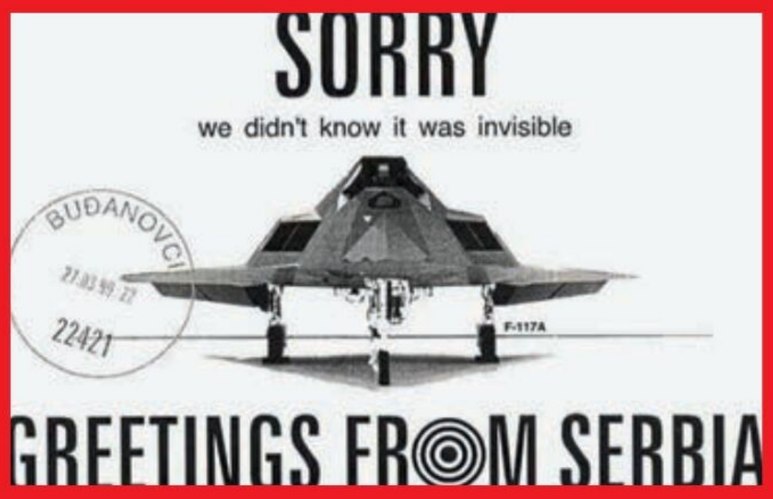
It seems most claims cannot be backed up and – considering the PR it would generate – if one has been shot down we would have proof, surely. Why? Consider the shoot-down of Lieutenant-Colonel Dale Zelko's Lockheed F-117A Nighthawk on March 27, 1999. The 250th Air Defence Missile Brigade of Yugoslavia, commanded by Colonel Zoltán Dani managed to do what many thought was impossible: shoot down a stealth fighter bomber. When they achieved the feat, the press generated from the resultant display of the wreckage was considerable. If there were any remains of an F-15 Eagle to be found as a result of an air-to-air engagement, surely we'd have seen it?

The first such claim against an F-15 unsurprisingly comes from the theatre of conflict where the Eagle itself claimed its first kill: the Middle East. It was claimed during 1978 that an Iraqi MiG-23 – possibly an MS or 'Flogger E' otherwise similar to the base B version – took down an Eagle. It was thought that a Flogger from 39 Squadron shot down an IAF F-15 in Iraqi airspace, but despite the claim being made many times over the intervening decade – no evidence or wreckage was produced.

In 1981 another alleged Eagle take-down was made in a like-for-like series of ambushes. The Eagle was a 'big-deal' purchase for the Israelis thanks to the MiG-25R overflights made from 1971 on: the IAF's F-4E Phantoms couldn't touch the fast and high-flying recce jets. A decade later and by now the IAF had the tool to take down the Foxbat. In February 1981, the story goes that a pair of Israeli F-15 Eagles ambushed a pair of Syrian-flown MiG-25s and shot one down. A few months later, it's alleged that the Syrians repaid the favour. In June 1981 they and Soviet sources claimed that MiG-25Ps of the SAF set up their own ambush, shooting down an IAF Eagle from beyond visual range with ripple-fired semi-active radar-homing medium range missiles.

Once more, no evidence was produced at the time and when you consider that the US Navy in the same year provided voice recordings of the Libyan Sukhoi Su-22 shoot-downs that took place on August 19, as well as hosted a press conference with the pilots involved, you wonder why the Syrians/Soviets didn't do the same, rather than simply repeat the claim and yet offer nothing in the way of evidence. Also, the Syrians apparently weren't even flying MiG-25Ps at the time…

But the plot does thicken: the Foxbat the Israelis shot down in February 1981 was a MiG-25R reconnaissance machine, flying over Lebanon as a single, while the Syrians claimed that the MiG-25P was a single when it shot down the Eagle in response. The Syrians' version was that a MiG-25PD (equipped with an infra-red search-and-track system, as well as chaff/flare dispensers and powerful Smerch A2 radar, and some electronic countermeasures equipment) played the part of a high-flying reconnaissance MiG-25 heading towards Beirut. Suddenly, two four-ships of IAF Eagles came up to intercept. The story then goes that the single MiG-25PD locked up his Smerch A2 radar and ripple-fired two AA-6



They would even display parts from the Nighthawk and Scott O'Grady's F-16 in a museum as well as produce some very cheeky posters!

Acrid/R-40 long-range missiles – possibly following Soviet protocol and launching the semi-active radar-guided version (R-40RD) after an infra-red version (R-40TD.)

Allegedly, the range was something like 35 miles, which was way above that of the AIM-7F Sparrows which equipped the F-15s, but within the advertised range of the R-40 (31-50 miles). This begs the question as to what order the Acrids were fired in. Normally, Soviet engagements would see the IR missile go first, so it didn't just follow the heat source from the SARH missile. Again – according to Syrian sources – the IAF F-15 crashed into the sea, north off the coast of Tyre/Lebanon. The Israeli pilot apparently ejected from his stricken Eagle. In the same combat, the IAF claimed to have shot down a MiG-25 Foxbat with an AIM-7.

A year later – in July 1982 – eight SAF MiG-21s took on a mixed formation of F-15s and IAI Kfirs over Beirut. The Syrians admitted to losing four of their own number but they did claim an F-15 Eagle too… Again, despite alleged eye-witness accounts no evidence was given or wreckage found to confirm the kill.

Fast-forward nine years to Desert Storm and it was the first chance for USAF F-15 Eagle fighters to take on the likes of the Iraqi Air Force's MiG-29s and MiG-25s… But first (once more) the Israelis were involved in another 'alleged' encounter. The Iraqi Air Force claimed that on the eve of Desert Storm – on January 4, 1991 – a number of IAF aircraft intercepted a formation of Israeli Air Force F-15 Baz fighters and shot one down near their H-3 Air Base, in western Iraq. A former retired high-ranking Iraqi officer claimed that the kill was valid and that the aircraft crashed with such force that only a few recognisable parts were found at the crash site. These were sent to Baghdad for investigation and apparently taken by US forces during Operation Iraqi Freedom in 2003.

The next alleged claim was on January 30, 1991, when two Iraqi Air Force MiG-25PDs were sent aloft to intercept what seemed to be a pair of USAF F-15Cs, which were on Combat Air Patrol between the Iraqi capital and the Iranian border, in a bid to stop Iraqi Air Force machines flying to Iran. It's thought that – initially – Iraqi GCI (Ground Controlled Intercept) sent the MiGs after a spurious radar return, against which one of the MiG-25s launched an R-40, but did not appear to hit a target.

The same pair of MiG-25s was then vectored to another 'pair' of USAF F-15Cs and an R-40RD was fired from between 10-15 miles away. At around the same time one of the F-15Cs ripple-fired two AIM-7M Sparrows, which missed their intended target as the MiGs made a fast, left hand turn and headed north. In the meantime, the Iraqis say they saw an F-15C going down and felt that the R-40 had done enough damage to make the aircraft a confirmed 'kill'.

The remaining Eagle is reported by the Iraqis as having fired no fewer than three more Sparrows, which failed, leaving the sole-surviving F-15C to bug-out to the south, to avoid the two Foxbats. The Iraqis then claimed that the MiG-25s left the area and headed at high-speed back to base, where they were nearly caught unawares by another pair of F-15Cs. The Iraqis say that three AIM-7Ms were fired at the two MiGs, with one impacting on the runway to the rear of one of the Foxbats as it ended its landing run.

Subsequently, the Iraqis who were tracking the targets, claim that one of the pair of F-15s from the earlier engagement was seen to slow down and disappear off radar somewhere in Saudi Arabia, leading to a probable kill, which was upgraded to a full kill when (allegedly) the wreckage of the aircraft was seen by a smuggler in northern Saudi Arabia.

From US sources, no fighter 'albino' F-15C was shot down during any of Desert Storm or the run-up to that campaign. The USAF did lose two F-15E Strike Eagles: one on the night of January 17, 1991, and another two days later – but these were claimed to have been destroyed by Iraqi ground-to-air defence units.

So what's the closest we've seen to an F-15 destroyed in combat? Sadly, the MiG-25/R-40 combination did destroy a McDonnell Douglas F/A-18C in the early hours of January 17, flown by Michael Scott 'Spike' Speicher – although initially US Forces claimed it was a ground-to-air missile that destroyed his Hornet and not an R-40D fired by Captain Zuhair Dawoud of the 84th Squadron of the Iraqi Air Force. Speicher was killed in the engagement, although it took many years before his remains were repatriated back to the US.

During what later became known as the Bekaa Valley Turkey Shoot, around 100 Israeli jets took on the same number of Syrian aircraft in one of the largest jet fighter-to-fighter battles ever fought. During this battle on June 9, 1982, a Syrian MiG-21 hit an F-15D Baz with an AA-8 Aphid (R-60) short-range infra-red dogfight missile. The Eagle was badly hit, but it managed to limp back to base and was repaired.

Bizarrely there has been an F-15 defection. During Desert Shield – the build-up to Desert Storm – one Royal Saudi Air Force pilot defected to Sudan (then a country with ties to Iraq) with his F-15C. In early November 1990, the pilot – who was said to be unhappy at the prospect of fighting fellow Arabs – took off on a training mission only to set course for Sudan.

In the immediate aftermath it was rumoured that the US Military in the Middle East were warning of a rogue F-15C that could be used in the area, but instead it was reported that the pilot was granted political asylum and the aircraft was returned to Saudi Arabia within hours, if not days. It was also rumoured that the Saudis may have made a considerable multi-million dollar 'donation' to the Sudanese government to aid in the Eagle's swift return.

Baz 957 was repaired and was soon back in service.

ONE WING ON MY EAGLE

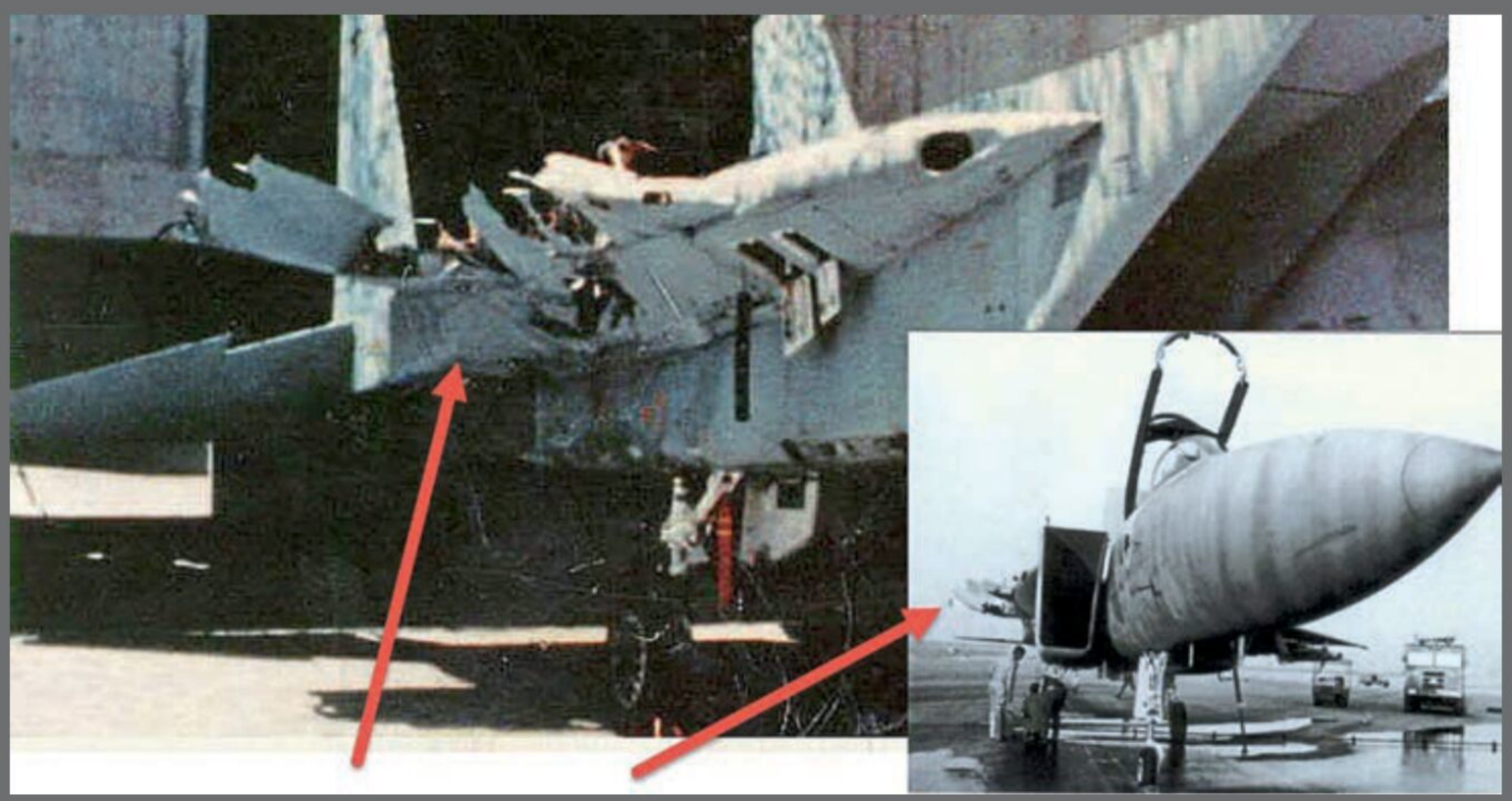
One aircraft that perhaps came closest to destroying an Israeli F-15 Baz in 'combat' was the venerable McDonnell Douglas A-4 Skyhawk.

These nimble little aircraft have been used by both the US Navy and the Israeli Air Force as 'Red Air' aggressors, using their agility to humble mightier opponents.

In May 1983, two IAF F-15Ds including one 106 Squadron F-15D Baz (957) named 'Sky Blazer' – were in mock combat with four A-4N Skyhawks over Nahal Tzin in the Negev when the two aircraft collided. Thankfully, the pilot of the A-4 managed to eject, leaving the two in the F-15D to their fate.

In the pilot's seat was Ziv Nedivi and his navigator Yehoar Gal. Initially they didn't realise the extent of the damage to the Baz, oblivious to the fact that most of the aircraft's right wing had been sheared off in the collision. Literally only a two-foot stump was left of the starboard wing, protruding from the wingroot/fuselage itself.

Nedivi recalled: "We were on a simulated airfield defence mission when it happened. I saw the number three man and he was upside down, while I was at 13,000ft-14,000ft. I fired a simulated missile and then we were 'stomach-to-wing' so we couldn't see each other. That's when we collided and the A-4 fireballed immediately. I then found myself nose-down at about



ABOVE: The damage done to the F-15 Baz was considerable.

30 degrees and the aircraft was spinning. I told Yehoar to 'prepare to eject' but when I lit the afterburners (not the normal thing you do in a spin) the spin stopped and the nose came up. I asked my wingman to inspect my plane, but the spray of fuel from the wing hid what was (or not) there."

After another spin after power was reduced, Nedivi found that control of the F-15D could be held but only with the application of lots of power. With Nedivi and Gal some 10 miles out from Ramon Air Base, the plan was to come in fast and make as safe a landing as they could. With the pair unaware that they were – in effect – flying on one wing, they made their approach at much faster speeds than normal. Nedivi explained: "A normal approach is around 130 knots, but we made ours at around 250-260 knots, about twice that of a normal landing. As a result of this I put down the F-15's emergency arrestor

ABOVE: Ziv Nedivi and his navigator Yehoar Gal.

ABOVE: This view shows just how much wing was missing!

hook which engaged the cable around a third of the way down the runway. We hit that, but the speed we were going meant that the hook itself tore off the aircraft and we eventually stopped 20ft short of the barrier at the other end of the runway."

The sight that awaited them was shocking. "I remember the last 50 knots on the runway and our wingman said 'you'll not believer what you flew in on'. When we came to a stop, I shook the hand of Yehoar and looked back to see no wing on my right-hand side. If I had seen that, I would have ejected…"

It seems that the wide-body of the F-15 acted as a 'lifting wing' and that – aided by the excess of power by the still-working F-100 turbofans, and other working control surfaces was just enough to keep the Baz in the sky. Interestingly, when McDonnell Douglas officials saw pictures of the damage, they were sure that it was from a taxying crash on the ground and didn't think it was possible for the aircraft to be flown in that configuration.

The aircraft itself – 957 – had already claimed four kills during 1982 and would go on to share another kill – a MiG-23 at the end of 1985. The IAF had been able to repair the damage and the aircraft lived to fight another day.

Nedivi is in no doubt to what saved him and Gal that day: "I'm not sure any other aircraft could have handled that damage and brought us home safely. The final testament is that an F-16 pilot friend who – after seeing the damage – said 'can I transfer to F-15s?'"

AWG-9 in their war against Iran – the Iraqis generally avoided the big Navy fighter.

Perhaps the truth is more prosaic and simply down to the USAF buttressing the air defences with the capable Eagle. Even the likes of other coalition Eagle users, the Royal Saudi Air Force, weren't placed at the very forefront of the action.

In fact – despite two kills by the same pilot on the same day – Ayhed Saleh al-Shamrani – history seems to be at the very least, somewhat disingenuous as to what happened on January 24, 1991.

With both kills being made by AIM-9P Sidewinders (don't forget both the F-15 Eagles and weapons delivered to the RSAF were a little behind the specification of those used by the USAF in 1991, hence they may not have had, let alone used AIM-9L/M all-aspect versions) questions were asked as to why the pilot was (allegedly) shepherded into position by AWACS right up to visual range where he could take down both of the Mirage F-1EQs, where his wingman was (if he had one) and why he hadn't tried to go for a BVR kill with AIM-7 Sparrows.

"Both the F-15C and E models showed themselves to be capable machines during Desert Storm and beyond..."

Maybe it was politics, for – even as back-stop CAP – it was worth the coalition's time to get other air-forces into the action (especially an Arab one). And when you consider that Ayhed Saleh al-Shamrani destroyed two aircraft that were supposedly intent on destroying a Saudi Arabian oil refinery, the job was eventually well done, whatever the support.

F-15 FACTS

Total number of F-15A-D, J and DJ models built by 2007 = 1198

A Lakenheath-based C-model with the latest AIM-120 and AIM-9X missiles: still potent after all these years.

EAGLE VERSUS RAPTOR

Mike 'Dozer' Shower graduated top of his class and got the pick of the various seats available to a USAF pilot – including slots as an F-111 pilot and a variety of places as an F-15C fighter pilot. He recalls: "So, I picked the F-15C slot at Elmendorf, Alaska and went from Tyndall in Florida up to Elmendorf, but my first F-15 flight was out of Tyndall in a two-seater and my second flight was one of those max performance take-offs. So many things are happening at once: it was summertime in Florida, hot and humid trying to catch up with the airplane as an F-15 in military dry power is like a T-38 in full afterburner! It takes time to work it out: eventually your mind catches up. It was like Star Wars when they hit light speed.

Dozer was in the F-15C community right at its peak during the 1990s through to the 2000s. He says: "Back then the F-15 was the best plane out there: it reigned supreme. It flew high (until the F-22 came along) had a big radar, but it was the weapons and training and sensors that made it." Mike would get a MiG-29 kill during Operation Allied Force over Bosnia on March 24th 1999, ripple-firing an AIM-120 and an AIM-7 Sparrow.

So, let's talk F-15C versus F-22A Raptor: Dozer?

"In an F-15 you're sensor operator, you're working the radar: you're the guy working this all out and managing the systems and putting together the 3D picture in your head. That's the difference with the F-22 Raptor. It does it all for you… you could take four weapons instructors in an F-15 each and you could have some lieutenant who is 'weapons clueless' and he's gonna find them all and kill them all. Then you put one really good guy in an F-15 against a Raptor and he's still gonna get killed, there's that much of a difference in technology. It's about sensors and training."

In 2001 there was a request for experienced pilots, F-15C pilots and ex weapons school and that meant that Dozer was going to get lucky and get to test the F-22 Raptor. He says: "By 2002 the Raptor was a bit behind time – the airframe and

ABOVE: Mike 'Dozer' Shower: F-15 and F-22 pilot.

ABOVE: The F-22 Raptor may be a league ahead of the Eagle, but many feel advanced Eagles could plug the gap between the two in the coming decades.

stuff was good, just not the electronics. I kinda termed the phrase 'offensive stealth and defensive stealth' as the F-22 can be offensive but the likes of the B-2 Spirit and F-117A Nighthawk have to run and hide, right? The F-22 is a different use: it flies fast and high, the F-117 is low and slow, while the B-2 is high and slow."

Initially – at Edwards Air Force Base – as is usual with a new platform, getting things to 'work' was an issue. Dozer says: "I was at Edwards for about a year and a half and we had a hard time to get two planes to work at same time. First day we had two planes to work, we had Langley F-15s next door and we are like: 'Hey, we've got two planes working, wanna come fly against us?'

So we hop in the jets and set up the two of us, we've done simulator stuff but we're not sure it will work. We take, we've off got tankers, we've got the F-15s and we try our tactics out. We set up the battles against different numbers of F-15s, up to eight against two Raptors and they just never saw us. We could hear them saying: 'Hey, where are you at?' and we are a mile behind them… These were combat experienced pilots we're talking about. It was really cool. This proved what the F-22 could do. I had one guy who had worked on the F-22 programme come up to us almost crying saying: 'Hey you validated my whole life's work.'

"We tested against F-15s, F-16s and then people realised it wasn't a joke or a theory: the F-22 worked. My favourite time was a Raptor four-ship versus 12 F-15Cs and we're like: 'let's see how quick we can kill these guys…' So we hook up way up high and supersonic and they can't take a shot and they're running away at Mach 1 and we kill them in two minutes or so. I was thinking 'this thing is unbelievable.' When the sensors work and each plane talks to each other, the Raptor is nearly untouchable when things are right. The F-22 versus a 4th generation fighter is like having two football teams against each other and one of them (the F-22) – is invisible!"

Extracts courtesy of Aircrew Interview; check out: www.aircrewinterview.tv/ www.facebook.com/aircrewinterview

AIR-TO-GR

Strike Eagles lined up as part of Desert Shield in 1990.

GROUND

IN THE EAGLE

The Strike Eagle was fresh into service when it got the call to drop its first bombs in anger. Since then it's matured into perhaps the finest multirole fighter-bomber the world has yet seen.

The F-15E Strike Eagle was blooded in Desert Storm and has seen action in many wars since. Today the Strike Eagle and its derivatives are among the most potent air-to-ground assets in the world.

CHAPTER 7 – AIR TO GROUND

ABOVE: ***F/A-18 Hornets, F-14 Tomcats, Lockheed Vikings, A-6E Intruders and EA-6B Prowlers share the ramp with Strike Eagles in Desert Storm.***

It was August 1990 and the 336th Tactical Fighter Squadron, known as 'The Rocketeers' had been flying their butts off.

The F-15E Strike Eagle was – at this time – a brand-new aircraft and one which had some old hands on the sticks as well as some new guys and they'd all been flying long hours and many sorties in a bid to get as proficient with their new fighting plane as possible. As part of the 4th Tactical Fighter Squadron at Seymour Johnson Air Force Base in North Carolina, the 336th was the first operational unit to receive the latest, multirole version of the F-15E. They'd said goodbye to their trusty F-4E Phantom IIs and that hurt, literally. As Captain James 'Chainsaw' McCullough so eloquently put it: "I have a two-hour butt – that means I can take about two hours on the hard, unforgiving seat of the Strike Eagle without getting sore."

So, in the summer of 1990, the F-15E Strike Eagle might have only been in service for a matter of around 18 months, been judged 'operational' for less than a year and ushered in a new era of accuracy and self-defence for the former F-4E and F-111 crews that climbed into that cockpit, but – well – it seems like the seat wasn't quite as comfy as that in the older aircraft.

And this was an issue for 'Chainsaw' and his squadron mates as they were looking forward to a 13-hour transit flight to Saudi Arabia to be part of 'Desert Shield'. With

"As Desert Shield began, units had just taken on the F-15E: this would be the aircraft's 'finest hour.'

Saddam Hussein's invasion of Kuwait in early August of 1990, many allied fighter and strike-fighter squadrons would find themselves part of the largest aerial armada put together since the Second World War: first as part of a protective force, to ensure Iraq did not strike out south and west and later as a strike force which would aim to destroy Iraq's ability to wage war, pushing the occupying forces out of Kuwait.

Chainsaw would eventually go to K-Mart and buy a 'rubber doughnut' cushion for the flight which took him and his squadron from Seymour Johnson to Thumrait, in Oman, before they moved to Al Kharj in Saudi Arabia. This cushion would last until he popped it while flying high-G manoeuvres in combat, but other upgrades would be coming that would make the F-15E more effective.

The 336th would be joined by the 335th squadron in-theatre and begin training for the action ahead. Many problems had to be ironed out during the build-up to Desert Storm: the F-15Es were new and so were some of the crews. While many were former F-4E fighter/attack guys, some came from the low-level strike F-111 and even close air support A-10 communities so therefore didn't quite have quite the handle on the air-to-air side of the mission as some. This was important as the Strike Eagle was expected to fight its way into and out of a target area.

With the expectation that any aircraft had to fly low to survive, training often went down to as low as 50-100ft – sometimes against direct orders from squadron commanders who didn't want to lose valuable men and machines. This and the need to make training as 'real' as possible led to some casualties across the various units and included a 336th F-15E crew on September 30: Major Pete Hook and Captain Jim Poulet who crashed in a training exercise. Other issues came from the 'newness' of the E-model. Some ordnance wasn't yet cleared for the Strike Eagle, such as the Mk.20 Rockeyes that were considered vital to the anti-tank mission, so – often – localised ingenuity by the men and women on the squadrons would simply make things happen themselves. Overall, it was an amazing feat to get these new airplanes and their pilots 'combat

ABOVE: The F-15E was a world away from both the F-4E and F-111.

LEFT: The F-15E Strike Eagle came to combat unproven and immature in its service career but proved itself in the 1991 campaign and beyond.

F-15 FACTS

The first F-15 crash was on October 17, 1975 – the result of a generator failure.

ready' and said a lot for the professionalism of everyone involved.

The action began when Operation Desert Storm started on January 17, 1991, when a force of 24 F-15Es attacked SCUD launcher sites in Western Iraq. Some of the Strike Eagles in that first effort were so loaded down with 12 Mk.20 Rockeyes, two fuel tanks and two AIM-9s that, according to Captain Bill 'Moon' Mullins in William L Smallwood's excellent book, Strike Eagle: Flying the F-15E in the Gulf War, "we were completely loaded and we had to lose two of our four Sidewinders to get down to our max gross weight of 81,000lb. When we taxied I was surprised to hear a THUMP, THUMP, THUMP underneath us and that was a result of the aircraft having sat with all that weight on it for 48 hours: it had moulded a flat-spot on the landing gear's tyres…" Further F-15E strikes were launched that night and one F-15E had a chance of bagging a MiG-29, but the AIM-9M missile that was fired failed to guide.

The Strike Eagle cadre's first combat loss came on January 18, when a petroleum plant was hit near Basrah. This was a target heavily defended by triple-A, SA-3s, SA-8s and French-built Roland systems. In this attack a pilot and his Weapons Systems Officer were killed. Two nights later another F-15E crew were hit by an SA-2 – but ejected safely and evaded capture for two days, until picked up by the Iraqis. Many aircrew in-theatre didn't think much of the supposed search and rescue provisions. Hence many F-15E crew would dump the standard issue 0.38 calibre revolver (with six bullets) and – before coming to the Gulf – would go to gun stores and purchase rapid-fire pistols with 15-shot clips and buy a second, loaded clip, just in case.

February 14 would see the Strike Eagle's most bizarre 'kill': a Mil-24 Hind gunship which was around 900ft in the air. F-15Es were requested by special forces as a number of Iraqi gunships were spotted in the vicinity. The lead Strike Eagle from the 335th squadron acquired one of the choppers via its Forward Looking Infra-red (FLIR) system and dropped a GBU-10 which went in right through the rotor disc.

On February 21, Strike Eagles from the 336th would show their prowess by destroying around 20 Iraqi Air Force jets on the ground at Tallil Air Base using cluster bombs and guided munitions.

The mission itself came about when then-Colonel David 'Bull' Baker (a former Vietnam War POW and later brigadier-general) was conversing with his twin-brother Steve who was serving with the US Navy and just happened to tell him of a picture taken by a recce-pod equipped F-14 Tomcat, of aircraft parked up, nose to tail near the air base itself. With this being such a tempting target, plans were drawn up to attack the area – but care had to be taken as the targets were around 250 yards from an important local shrine: the Strike Eagles would have to be precise.

Four F-15Es 'visited' the target and Bull Baker and his WSO Captain Mark 'Bones' Wetzel would play their part in the destruction. Baker – who sadly died in 2009 – would later report: "We were eventually lasing a bomb on an aircraft with each pass. We'd hear: "We got a Fishbed! We got a Flogger! We got a Frogfoot! We got an F-1! What we were all doing was pretty impressive. We got a direct hit on a Mirage F-1 and this thing comes shooting out of the fireball – it was the ejection seat. We hung about for 40 minutes and took out 18 airplanes. We denied them a whole squadron of fighter aircraft. It was a good night's work." The destruction was valued at around $200 million worth of front-line aircraft!

During Desert Storm, the F-15E and other allied aircraft would move from low to mid-level attacks: the destruction on Tallil was made at between 20,000-22,000ft. As one F-15E crewman, Captain Chris Hill said: "King Kong with a noose around my nuts could not drag me down to low altitude again."

BEYOND DESERT STORM

F-15Es would stay in Iraq after the ceasefire and the Iraqis' withdrawal from Kuwait. Strike Eagles would take part in Operations Southern and Northern Watch, working from bases in Turkey. In December 1998, F-15Es took part in Operation Desert Fox, once more seeing action and supporting operations in Operation Provide Comfort.

F-15Es out of Aviano Air Base, Italy, and RAF Lakenheath in the UK would also take part in air operations over the Balkans, which took place between late 1993 and 1999, from Operation Deny Flight, through Operation Deliberate Force, to

Operation Allied Force. A number of firsts during this time included the first USAF F-15E employment of the GBU-15 glide bomb, the AGM-130 stand-off, powered air-to-ground missile and the dual use of Strike Eagles as both fighter and bomber, indulging in air-to-ground and combat air patrols often in the same mission.

Just weeks after the September 11 attacks in New York, F-15Es were rushed to Kuwait to support Operation Enduring Freedom over Afghanistan. As well as targeting Taliban headquarters, the Strike Eagles would find themselves putting the 'close' into close-support. In fact, two F-15Es of the 391st spending nearly 16 hours in the air – nine of those over the target – on one mission. They attacked two Taliban command and control facilities and had to refuel 12 times during the mission from the support tankers. It was reportedly the longest fighter/strike mission ever flown.

OPERATION IRAQI FREEDOM THROUGH TO TODAY

By the time the F-15E Strike Eagle 'returned' to Iraq in early 2003, it was a seasoned warplane. During Iraqi Freedom, F-15Es were credited with destroying 65 Iraqi aircraft on the ground and 60% of the Iraqi Medina Republican Guard, as well as destroying many vital command and control buildings in and around Baghdad.

With the rising of the so-called Arab Spring from 2010, F-15Es took part in Operation Odyssey Dawn, which was part of the Libyan 'No-Fly' Zone which was enforced from March 17, 2011. Four days later the crew of a Strike Eagle were successfully rescued by US forces, after they were forced to eject over Benghazi – then held by the Libyan resistance.

"As the Strike Eagle proved itself in combat, more nations decided to purchase their own versions of the F-15E..."

The ongoing battle against Islamic State or Daesh, has also seen the Strike Eagle play a leading role. Operation Inherent Resolve has been the USA's main thrust against Islamic State in both Iraq and Syria, while USAF F-15Es also flew long-range missions from RAF Lakenheath to hit IS-targets in Libya. Much use has been made of footage taken from the F-15's AN/AAQ-33 SNIPER targeting pods and – according to press reports – strikes by the F-15Es have also led to the deaths of several prominent Islamic State leaders.

With the USAF's Strike Eagle force undergoing a Radar Modernization Programme (RMP) with the first Raytheon AN/APG-82 being delivered at the end of 2010, as well as upgraded weapons, it seems the F-15E Strike Eagle will be on duty for some time to come.

F-15 FACTS

The largest F-15 fleet outside the USA is operated by Japan, which has 200.

The first multirole or 'ground pounding' missions for the F-15 were undertaken by the Israeli Air Force long before the USAF used such a machine.

THE MULTIROLE EAGLE IS BORN

Following the use of Baz F-15Ds in air-to-ground sorties, the IAF was keen to buy an F-15E derivative, suited to its own uses.

Once more the tactical use of the F-15 in a multirole guise was pioneered by the Israelis.

In October 1985 and in a daring raid called Operation Wooden Leg six F-15Ds from No.106 Spearhead squadron and two F-15C Baz machines, from 133 Twin Tail squadron flew more than 1200 miles from bases in Israel to hit the Palestinian Liberation Organisation's headquarters in Tunisia. The strike was in response to the alleged murder of three Israelis on a yacht anchored in Larnaca, Cyprus, whom the PLO said were spies. The mood from the Israelis was hot: Defence Minister Yitzhak Rabin, said: "The IDF will always find and punish those responsible." The go-ahead for the mission was given by Prime Minister Shimon Peres.

The distance – from Israel and across the Mediterranean – was (at the time) the longest-range strike put together by IAF aircraft, the longest since the famous 1976 'Raid on Entebbe'. The target was the PLO HQ in Hammam Chott, near Tunis which was around 1280 miles from Tel Nof, from where the F-15s would be launched.

Everything came together in this raid – not only the IAF's new air-to-air refuelling capabilities with the two Boeing KC-707 tankers, but also the increased (2000lb) internal fuel of the F-15C/D model Eagles.

With this being the first air-to-ground use of the F-15, it was a time of many 'firsts' for the airframe itself. The F-15A, B, C and D did have some latent (if primitive) ground -ttack potential, which was (for various reasons) not pushed forward within USAF service. This meant that the Baz models used by the IAF could use the basic 'dumb' bombs then

Many IAF F-15s of all versions received Israeli systems in place of US equipment.

in service, such as the Mk82, Mk83 and Mk84 general purpose bombs.

For Operation Wooden Leg, more accuracy was needed that that offered by dumb bombs, so the six F-15Ds were equipped to launch the GBU-15. This was a 2000lb guided 'glide' bomb, which was steered to the target via the back-seater. A data-link pod mounted on the Baz's centreline pylon ensured communication between the carrier aircraft and the weapon, which had a range of anything between 10 miles and 25 miles.

Joining the six F-15D two-seaters were the two F-15Cs, armed with six 500lb Mk82s general purpose bombs on MER (multiple ejector racks) attached to the Baz's center pylon – these would be the last into the target. All the Eagles flew with AIM-7F Sparrows and Sidewinder IR missiles as well as their internal cannon for any self-defence issues.

The mission itself was a feat of both logistics and tactics. A picket ship with a search and rescue helicopter was stationed in the Med to be ready to pick up any downed pilots. And the IAF F-15s had to avoid radar detection by not only Middle Eastern enemies, but those on the north coast of Africa and the US Navy prowling on the area too.

All aircraft in the mission had any squadron identification marks and national insignia removed – the latter being over-painted with orange squares – and they made it to their targets undetected at around 11am. The formation then split into two flights of four, with a four minute separation between them. Two of the Eagles suffered issues and were forced to abort. "We felt intense pressure during those few seconds," said one of the pilots involved. "We had a good dose of adrenaline in our blood, and we were totally focused on our goal. When we reached our destination, we found our targets and fired our ammunition at the target."

The first three Eagles released their GBU-15s from around 15 miles away from their target. The second flight began its attack, with two F-15Ds releasing their GBU-15s. These were then followed by two F-15Cs, one of which dropped its Mk.82s on the first run. The other made a circle and then re-commenced the attack from a different direction because of dense smoke covering the target. They were joined by flight lead, who observed the damage for assessment by the IAF.

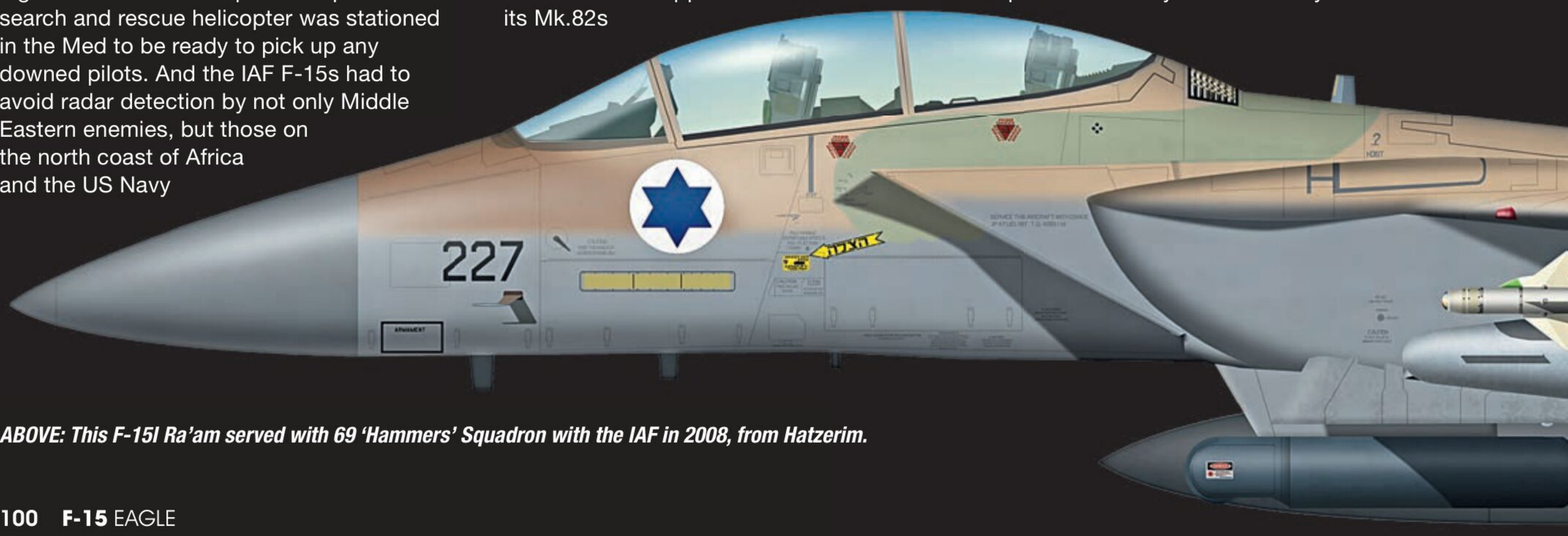
The attacks resulted in condemnation from the international community – even from the US (who allegedly helped with intel before the raid). As far as casualties were concerned, Israel claimed that around 75 people were killed — around 60 of whom were PLO members — others claimed up to 56 Palestinians and 215 Tunisians were killed, and about 100 wounded. Official Tunisian sources put the final count at 47 dead and 65 wounded.

If anything, this mission showed the US how potent a strike-configured F-15 could be. Their own F-15 Strike Eagle was already in development and would fly around a year after Operation Wooden Leg. Meanwhile, the IAF would finally get their own version of the Strike Eagle when it ordered 21 F-15I Ra'am aircraft in January 1994.

The Ra'am's first combat mission took place in January 1999 and they have been

F-15 FACTS

The IAF fixed a wrecked F-15B by attaching the undamaged front end to the rear of an old F-15A.



ABOVE: This F-15I Ra'am served with 69 'Hammers' Squadron with the IAF in 2008, from Hatzerim.

ABOVE: Two IAF Ra'ams on their take-off roll…

LEFT: You can see the various hardpoints on this Ra'am.

in almost constant use ever since, with many being upgraded. Perhaps the most notable combat mission was Operation Outside the Box, which took place on September 6, 2007. This was a joint F-15I/F-16I Sufa attack on a suspected Syrian nuclear reactor. Other notable uses of the Strike Eagle-derived F-15 in the Middle East includes the Royal Saudi Air Force's use of the F-15S in Yemen since 2009.

The EYRIE

Around 1700 F-15 airframes have come off the McDonnell Douglas/Boeing production line and continue to do so today.

Japan is the one place where the Eagle has been built under licence – as the F-15J and DJ models.

The Israeli Air Force has large numbers of F-15 aircraft in its inventory, using some of the earliest F-15A models, through to their own version of the F-15E Strike Eagle – the F-15I Ra'am.

CHAPTER 8 – THE EYRIE

Even the first prototype of the F-15 was big, brash, powerful and expensive – but even so it was clearly seen that the Eagle's airframe was ripe for development and overseas sales: if only a nation other than the USA could afford it.

The overall shape of the F-15 was so 'right' from the outset that – even today – you're hard pushed to see the differences between the first 'TF-15' and today's cutting-edge F-15QAs that are currently rolling off the production line at St Louis for Qatar.

> ***"From the first prototype through to the latest F-15SA, the Eagle looks like the original McDonnell Douglas machine from way back in 1972..."***

THE PROTOTYPES

The overall shape of the McDonnell Douglas F-15 was proven with the use of three RPRVs (Remotely-Piloted Research Vehicles) which gathered much data on the overall aerodynamics of the F-15. These 23ft-long 'models' with a 16ft wingspan were around three-eighths the size of the full-size Eagle and were dropped from NASA's Boeing NB-52 Stratofortress. After the first flight of the actual Eagle the RPRVs were given to NASA late in 1972 and flown up until the end of 1981.

Twelve original prototypes of the F-15 were built by McDonnell Douglas for trials purposes and based at Edwards Air Force Base, California. The first prototype was F-15A 71-0280 (known as F-1 in-house) and this was rolled out at St Louis on June 26, 1972 before being ferried by a Lockheed C-5 Galaxy transporter to Edwards AFB. This very aircraft was the first full-size Eagle to take to the skies on July 27, 1972. The pilot chosen for this big event was Irving 'Irv' Burrows who remarked: "Wow! It flew just like it did in the simulator." This first airframe explored the overall flight envelope, handling trials and initial stores carriage before the second aircraft – 'dash 0281' or F-2 which first flew on September 26th and was used to test the then-new-to-service Pratt & Whitney F-100 engine. Before the end of 1972 these would be joined by a third F-15A, '-0282' or F-3 used to test avionics and the new APG-63 radar.

For 1973 six further A-model prototypes would join the Edwards test fleet, 0283 (F-4) would be a structural test airframe – this aircraft also using smaller wingtips in a bid to eradicate a buffet issue on earlier machines, 0284 (F-5) flew in March and was utilised for armament development, being the first F-15 airframe with the internal General Electric 20mm Vulcan cannon. Airframe 0285 (F-6) would fly in May and test the avionics/radar and the fire control system, while F-7/0286 – which first flew in June – was testing external fuel tanks and joined other airframes for armament testing.

The first two-seater evaluation test with '0290/TF-1'also took place in 1973 on July 7 followed in August by F-15A '0287 or F-8' – which handled spin recovery testing, necessitating the fitment of the bulky but vital spin-recovery parachute. In 1976 this airframe would be given to NASA for an engine development programme. In the October of 1973 '0288/F-9' first flew and would also join the engine test team before a life with McDonnell Douglas as a test airframe through to the late 1980s, while a second TF/F-15B would take flight in October as a test and demonstration aircraft. This was the famous machine which was painted in bicentennial markings for a whistle-stop tour of the world in 1976. This aircraft would be a hard-worked airframe, becoming as it did the prototype Strike Eagle as well as being the first F-15-based airframe to use the Conformal Fuel Tanks or 'FAST' packs (Fuel And Sensor Tactical) as they were then known.

Come the early new year of 1974 and another A-model the out-of-synch '0289/F-10' would join the trials fleet helping to further develop radar, avionics and newer electronic warfare equipment. Many of the prototypes would find use with NASA for trials and experiments or with their parent company after the trials had ended.

F-15 FACTS

The Streak Eagle could climb faster than the Saturn V moon rocket!

RESEARCH/TEST/RECORD BREAKING VARIANTS

McDonnell Douglas F-15 Streak Eagle: Built for one purpose only – that of breaking a series of time-to-height records. F-15A number 72-0119 was left unpainted and stripped of any unnecessary equipment. Between January 16 and February 1, 1975, it broke eight world records at Grand Forks Air Force Base, North Dakota. Amazingly, the figures showed that the Streak Eagle was some 10 seconds quicker to 15,000ft than even a Saturn V moon rocket. Some five years after the record-breaking flights it was delivered to the National Museum of the United States Air Force. The records were beaten by a similarly stripped-out Sukhoi Su-27/P-42 Flanker between 1986-1988.

F-15A number 71-0285 seen at Edwards AFB on October 4th 1979.

ABOVE: *A 32nd TFS36th TFW F-15A (77-0081) seen at Greenham Common in June 1977.*

RIGHT: *McDonnell Douglas F-15 (72-0119) was the Streak Eagle but was so different to a production F-15A it was simply repainted and used as a museum piece.*

McDonnell Douglas F-15 STOL/MTD: Originally one of the main 12 prototypes and the first F-15B two-seater to fly, 0290 was much-modified to investigate and conduct research using the F-15 Eagle as a 'STOL' Short-Take-Off and Landing aircraft. Redesign in 1986-1987 saw the standard 'tailed' airframe receive canard flight surfaces mounted on the intake trunks and peculiar-looking square nozzles which could vector thrust from the Pratt & Whitney F-100 turbofans. The 'MTD' stood for 'Manoeuvre Technology Demonstrator.'

McDonnell Douglas F-15 ACTIVE: 0290's next adventure was testing advanced flight control technology with the thrust-vector capability of the airframe/powerplants. Loaned to NASA from June 1993 it was used as a testbed for a number of advanced research projects based at the Dryden Flight Research Centre at Edwards AFB. The ACTIVE (Advanced Control Technology for Integrated Vehicles) project looked at improvements in cruise speeds and trim drag reduction during cruise flights or manoeuvres: basically looking at areas of the flight envelope that would be probed 'in production' by the 5th generation fighter – the F-22 Raptor. The ACTIVE programme lasted until 1999 but 290 was used until 2008 in research at Dryden for Intelligent Flight Control Systems (F-15 IFCS.) By the time 290 was finally retired in 2009 it was then the oldest F-15 airframe still flying.

McDonnell Douglas F-15B 'Quiet Spike' NASA: Having a USAF serial number ending in 0141, this research test-bed was acquired by the National Aeronautics and Space Administration in 1993 where it flew under the tail-code '836'. This was used in the 'Quiet Spike' programme, where NASA was looking at technology with which the next generation of supersonic transports could actually fly over populated areas at more than the speed of sound without creating the intense 'sonic booms' that saw Concorde banned from so many of the world's most lucrative long-haul routes in the early 1970s. The technology was actually a 7.3m long 'spike' which created three smaller shock waves, resulting in much less sound disturbance on the ground. The trials ended in 2007. Other NASA test airframes included F-15A models '0281' and '0287' for various new systems including a Self-Repairing and Self-Diagnostic FCS (Flight Control System) among other systems.

"With the F-15 being at the cutting-edge of aerodynamics, it's little wonder that the airframe was used in a mulititude of forms over the decades."

PRODUCTION VARIANTS

McDonnell Douglas F-15A Eagle: The original baseline, single-seat, all-weather air-superiority fighter version of the Eagle. Selected by the USAF back in 1967, it first flew on July 27, 1972, and entered service on January 9, 1976. The basic specification included the Hughes (later Raytheon) AN/APG-63 pulse-doppler radar set and Pratt & Whitney F-100-PW-100 engines each rated at 14,760lb of static thrust and 23,830lb in afterburner. Original armament consisted of the M61-A1 Vulcan rotary cannon in the starboard wing-root with 940 rounds. Armament was four AIM-9P Sidewinder short-range infra-red homing missiles and four AIM-7F/M Sparrow semi-active radar-homing missiles semi-recessed on the bottom of the fuselage/intake trunking. A total of 384 F-15As were built between 1972 and 1979.

McDonnell Douglas F-15B Eagle: Originally designated TF-15A, this was the fully combat-capable version of the single-seat F-15A Eagle. Still equipped with the APG-63 radar, 20mm cannon and full fuel and missile complement, the second seat necessitated the loss of some non-essential avionics. The first F-15B entered service on November 14, 1974. A total of 61 were built between1972-1979. A number of early model A/B Eagles were initially scheduled to go through the MSIP upgrades (see below) but for economic

***ABOVE:** The McDonnell Douglas F-15 STOL demonstrator would also later utilise thrust-vectoring F-100 engines.*

reasons many were donated to museums while a number were given to the IDF-AF as thanks for Israeli restraint during the 1991 Gulf War. For more see 'F-15 Today'.

McDonnell Douglas F-15C/D Eagle: It was always going to be the case that soon after the introduction of the F-15A a definitive fighter version with various updated would be made – this would become the F-15C. Largely identical to the previous models, space was found for a further 2000lb of fuel internally while the FAST Packs (Fuel And Sensor Tactical – later simply CFTs or Conformal Fuel Tanks) were finally available to fit to C/D models of the Eagle.

Other changes were made to the Pratt & Whitney F-100 engine. Early C/Ds were powered by the existing F-100-PW-100 motors, but things were to change. With some early teething problems with the F-100, the C/D models would (eventually) get the much more reliable (if slightly less powerful) F-100-PW-220. Internally, avionic changes were also made. The first F-15C/Ds would benefit from the AN/APG-63 PSP (programmable signal processor) radar from Hughes (later Raytheon) and improved electronic warfare/ electronic countermeasures equipment.

The first F-15C (78-0468) flew from McDonnell Douglas' St Louis plant on February 26, 1979, with the F-15D flying on June 19. These first examples would use the earlier PW-100 motors, but from 1985, all production F-15C/Ds would use the PW-220. The radar would also be improved during the C/D's production. From 1989 the AN/APG-70 radar was fitted to the last 43 F-15Cs delivered. This was a much-improved version of the very successful APG-63 set. Improvements in electronics

"From short take-off and landing variants, to thrust vectoring, F-15 test aircraft would push the boundaries of flight."

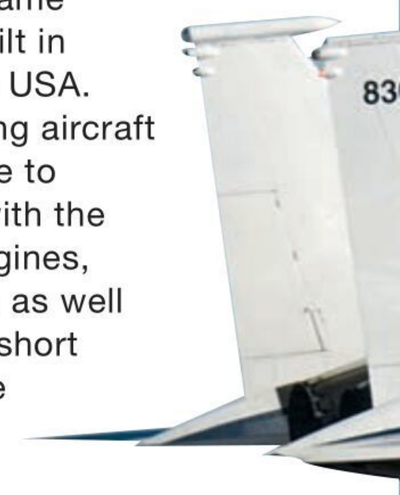
over time meant more processing power for the APG-70 (five times quicker than the 63) while other small improvements would come over time, including the allocation of the AN/APG-63(V1) radar and subsequent upgrades that are planned for the 'Golden Eagle' fleet survivors.

This was part of the MSIP II (Multi-Stage Improvement Program II) which saw a number of upgrades, including the APG-70 (and subsequent ability to launch the 'fire and forget' AIM-120 AMRAAM) as well as some other notable upgrades. These included an overload warning system to help stop pilots over-G-ing the airframe, jamming-resistant radios under the Seek Talk programme, GPS navigation, a new Electronic Warfare Warning Set with the introduction of the Tactical Electronic Warfare System (TEWS) along with the ALQ-135 ECM set and ALR-56C RWR (Radar Warning Receiver). Also included was the JTIDS or Joint Tactical Information Distribution System which reliably allowed information to be shared quickly between aircraft and ground forces including control centres. The first MSIP II F-15C flew on June 20, 1985.

A total of 483 F-15Cs were manufactured for the USAF and exported between 1979 and 1985 with 92 F-15Ds being built over the same timescale.

McDonnell Douglas F-15J Eagle: Single-seat version of the air-superiority fighter built for (and by) the Japan Self-Defence Force. Two were originally built by McDonnell Douglas in St Louis, with the remaining 139 built under licence in Japan by Mitsubishi Heavy Industries during 1981-1997. Based on the C-model, the only major difference was the deletion of the USAF version's ECM radar warning and latent nuclear weapon delivery ability. The F-15DJ essentially the same as the B/D Eagle, with 25 built in Japan and 12 by MDD in the USA.

Around 100 of the surviving aircraft underwent a mid-life upgrade to bring them largely into line with the USAF's MSIP II. Updated engines, radar and computer systems as well as indigenous missiles both short and medium range keeps the F-15J/DJ fleet current in today's air-to-air climate.



McDonnell Douglas/ Boeing F-15E Strike Eagle: A derivative of the two-place F-15 airframe equipped with conformal fuel tanks (CFTs) finally utilising the latent ability of the Eagle to drop bombs and hit ground targets.

These basic abilities were brought together in a McDonnell Douglas funded company demonstrator to prove the concept of the 'Strike Eagle', basically a long-range interdictor or 'bomb truck' but one which had a useful self-defence capability. The second 'TF-15' airframe (0291) was modified and flew on July 8 as the Advanced Fighter Capability Demonstrator. It was a timely move as in March 1981 the USAF announced the Enhanced Tactical Fighter Programme to search for a successor to the General Dynamics F-111 low-level strike aircraft. The F-15E was selected in 1984.

The Strike Eagle used the two-seat F-15 airframe utilising two Pratt & Whitney F-100-PW-220/229 engines, married with CFTs to advanced sensors (including LANTIRN – Low-Altitude Navigation and Targeting Infra-Red for Night), updated AN/ APG-70 radar and a suitable colour scheme for the low-level strike role. It's been since developed into a variety of sub-types for various air forces. As the F-15E Strike Eagle for USAF service, around 236 were built between 1985 and 2001, seeing its first combat in Desert Storm of 1991.

Upgrades to keep the Strike Eagle current have included upgrading the radar to the latest AN/APG-82 AESA radar from 2007.

Boeing F-15I Ra'am: Ordered following the 1991 Gulf War, this was in response to Israel's need for a long-distance strike aircraft, following the IDF-AF's successful use of the two-seat Baz in this role. Following this is a made-for-Israel version of the F-15E. The Ra'am (Hebrew for 'Thunder') is powered by the same P&W F-100-229 combination as the F-15E, but crammed with indigenous Israeli electronic equipment: most notably the use of a pilot's (and WSO's) helmet-mounted sight, giving the F-15I this advantage over the

McDonnell Douglas/NASA F-15B with 'Quiet Spike' supersonic noise reducer boom.

***ABOVE:** An F-15D moves in towards the re-fuelling boom.*

F-15 FACTS

The F-15 originally carried around 1000 rounds for its cannon. Modern F-15s carry about half that.

USAF's F-15E.

Other locally-produced equipment includes Israel's own RWR (Radar Warning Receivers) as well as the Elisra SPS 2110 EW (Electronic Warfare) suite and GPS/navigation systems. It also uses the Ra'am-specific AN/APG-70I. This version of the venerable AN/APG-63 and its derivatives gives ease of maintenance, using some common modules from both the APG-73 of the F/A-18 Hornet and some from the APG-71 seen on advanced versions of the US Navy's Grumman F-14 Tomcat.

On IDF-AF Ra'ams, it's reported that the air-to-air modes are identical to those on the USAF's Strike Eagle force, which means it can detect a large airliner-sized target at 170 miles (280km), and fighter-sized targets at 64 miles (104km). The air-to-ground performance and resolution is not so high as the American aircraft, reportedly only two-thirds of the performance of the USAF F-15E. Podded sensors have included both Sharpshooter and LANTIRN pods.

Israel first used the Ra'am in anger during 1999 and the aircraft will feature in the IDF-AF's line-up for some years to come. It will therefore be subject to a number of upgrades. It was announced in January 2016 that the Ra'am fleet will be upgraded structurally and with new avionics, including an AESA radar and new weapons systems.

Boeing F-15K Slam Eagle: Another off-shoot from the F-15E Strike Eagle family, the F-15K 'Slam Eagle' serves the Republic of Korea Air Force in versions with two different powerplants. The first 40 aircraft ordered from 2002 are powered by the General Electric F-110-GE-129 motor, with 21 ordered from April 2008 under the 'Next Fighter II' programme being powered by the Pratt & Whitney F-100-PW-229 EEP (Engine Enhancement Package) motor. Depending on what spec sheet you believe, there's only a few hundred pounds of thrust between the two – in the GE motor's favour: (29,160lb in afterburner compared to the F-110's 29,400lb).

The Slam Eagle was first ordered by the Republic of Korea in 2002, with first deliveries commencing in October 2005 and the last of 40 aircraft (of either powerplant) being delivered in 2012. ROKAF's Slam Eagles feature a high degree of licence-built components, with South

Still in service: F-15C 81-0032 'ZZ' takes off from Eielson Air Base during Red Flag.

Korea producing 40% of the parts for each machine and 25% of the final assembly, including fuselage and wings from Korea Aerospace Industries. The Pratt & Whitney F-100 engines and General Electric F-110 motors are also licence produced.

Up front the radar is a development of the AN/APG-63(V)1 used in the F-15C, with air-to-ground elements of the AN/APG-70 added to meet Korea's needs more adequately (notably in the sea/surface track modes). The end result is one of the most flexible fighter/bomber radars in use today and one which can be easily upgraded with an AESA radar array in the future. The modern cockpit is fully night-vision goggles capable as well as using the Joint Helmet Mounted Cueing system (JHMCS). Weapons include the latest AIM-9X Sidewinder, AIM-120C AMRAAM (both can be used with the AAQ-14 pod for infra-red search and track engagements) AGM-84H Harpoon Block II anti-ship missile, AGM-84K SLAM-ERs and in the future any new 'stealth' stand-off missiles currently in development. So far two Slam Eagles have been lost in service as of July 2018.

The Slam Eagle beat many '4.5' generation aircraft to win the contract – including the Dassault Rafale, Sukhoi Su-35 and Eurofighter Typhoon. With various upgrades the Slam Eagles are expected to be in service until 2060.

Boeing F-15S Eagle: Following the F-15E's performance in Desert Storm, the Royal Saudi Air Force showed interest in a version of the Strike Eagle. They initially looked at a single-seat F-15F version (see below) but in the end were able to order the F-15XP (Export) later called the S for Saudi.

After much political toing and froing, it was finally announced in October 1992 that the RSAF was allowed to purchase a version of the Strike Eagle under the 'Peace Sun' project name, one of the most lucrative US military aviation deals then completed.

The F-15XP became the F-15S, and was – effectively – a slightly downgraded version of the E-model.

The RSAF initially bought 72 aircraft, utilising the Pratt & Whitney F-100-PW-229 powerplant and from that total around 48 were going to be fully configured for the air-to-ground role, although all would be multirole and use CFTs. The S-model made its first flight in June 1995 and deliveries commenced soon after until completed in 1999. Performance was (once more) downgraded, similarly to the F-15I, with the AN/APG-70's capabilities being less than that of the USAF Strike Eagle force, as was the performance of other sensors, including the LANTIRN pods supplied.

Boeing F-15SG Eagle: In 2005 the F-15SG was chosen over the Dassault Rafale following a seven-year evaluation against a number of modern aircraft to provide the Republic of Singapore Air Force with its multirole clout, replacing the retired McDonnell Douglas A-4SU Super Skyhawks.

As a result, an order for 12 F-15SGs was placed with Boeing. These would be powered by the General Electric F-110-GE-129 turbofans capable of more than 29,400lb of thrust. The radar would be the AN/APG-63 (V)3 AESA with full air-to-air and air-to-ground capabilities. Included in the deal were AMRAAMs, 9X Sidewinders and AGM-154 JSOWs. The cockpit came with and was suitable for NVG operation (Night Vision Goggles) while the aircraft were able to use the Link-16 data-link to share information with other aircraft. The first machine was rolled-out in November 2008 and delivered the following May with final deliveries ending in summer 2017.

Boeing F-15SA (Saudi Advanced) Eagle: Following on from the successful introduction of the F-15S into RSAF service in the 1990s, the F-15SA has since entered service as both a new-build variant of the potent strike-fighter as well as an upgrade to existing F-15S airframes.

The biggest change is to the powerplant, with the General Electric F-110-GE-129C engine replacing the Pratt & Whitney F-100. In a $300 million contract, GE sold 65 engines to power/replace the P&W F-100s in existing F-15S aircraft. In addition the SA-model uses a modern digital fly-by-wire FCS (flight control system/DFBW) uprated EWS (electronic warfare systems, the BAE Systems' Digital Electronic Warfare System (DEWS) and Common Missile Warning System (CMWS) and all-new cockpit with large area displays, helmet-mounted displays (as well as a Wide Field of View (WFOV) HUD, the AN/AAS-42 'Tiger Eyes' infra-red search and track system (IRST) and the AN/APG-63 (V)3 AESA radar – making it one of the most technologically advanced Eagles in service anywhere.

The deal for the production of the F-15SA was announced at the end of 2011 and the agreement covered the production of 84

F-15 FACTS

While Japan has manufactured the F-15, Korea has made parts for their own versions.

displays (as well as a Wide Field of View (WFOV) HUD, the AN/AAS-42 'Tiger Eyes' infra-red search and track system (IRST) and the AN/APG-63 (V)3 AESA radar – making it one of the most technologically advanced Eagles in service anywhere.

The deal for the production of the F-15SA was announced at the end of 2011 and the agreement covered the production of 84 'new-build' F-15SAs and the upgrading of 70 F-15S machines from the RSAF inventory, as well as back-up, training and spares/sensors and weapons, including the AN/AAQ-33 SNIPER advanced targeting pod.

In air-to-air guise the F-15SA can carry up to 16 air-to-air missiles (the latest AIM-9X off-boresight short-range AAM and the AIM-120C-7 AMRAAM) – utilising the out-board wing hard-points for the first time: that's double the typical loadout of the F-15C pure fighter. Air-to-ground the SA packs a thoroughly modern punch, utilising AGM-84 SLAM-ERs, JDAMS, the GBU-39 SDB (Small Diameter Bomb) as well as anti-radiation HARMS. The first aircraft flew in February 2013 and the first RSAF aircraft was delivered at the end of 2016. Initial snags were found when developing the digital fly-by-wire (DFBW) control system with more than 18 months spent in testing.

"Many 'paper' F-15 projects existed, including RAF F-15Cs and a navalised, Phoenix-carrying F-15N for 'Navalised!'"

Boeing F-15QA Eagle: Similar to the SA Eagle, 72 examples of the QA (Qatar Advanced) were ordered late in 2016. This also features the General Electric engine, the AN/APG-63 (V)3 AESA radar, up-to-date EW equipment, full DFBW systems and advanced sensors/targeting pods and weapons.

'PAPER PROJECTS'

McDonnell Douglas F-15N Sea Eagle: With the high cost implications and doubts concerning the General Dynamics F-111B from the late 1960s and the Navy's replacement interceptor – Grumman's F-14 Tomcat – the F-15N was almost considered to be a 'safe option' to the riskier Tomcat programme.

Two versions were mooted, the first initially in 1971. This was to be a basic 'navalisation' of the standard F-15A airframe. By this time the first flight was a year away but the design was mature and being 'tested' in McDonnell Douglas' advanced simulator.

This F-15N then would simply carry the same Sidewinder/Sparrow armament as the baseline F-15A, with the Hughes AN/APG-63 radar. Navalisation would come in the form of folding wingtips and a much reinforced landing gear and tailhook for repeated carrier landings. Despite these additions making the standard F-15A some 3100lb (1409 kilos) heavier in the F-15N, McDonnell Douglas (with huge experience of carrier-borne fighters thanks to the previous F-4 Phantom II) was confident that the agility, speed and excellent thrust-to-weight characteristics of the Eagle would make for a superb US Navy interceptor.

The key here was the issues coming forth

An F-15E Strike Eagle.

ABOVE: This Boeing F-15K served with the 1st Fighter Wing of the Republic of Korea Air Force in 2009. It is armed with AIM-9X Sidewinders, the AIM-120 AMRAAM and SLAM-ER air-to-ground store.

CHAPTER 8 – THE EYRIE

with the F-14's powerplant – the Pratt & Whitney TF30, which was already showing signs of weakness. It was thought the P&W F-100 offered improved reliability – although history would prove that the otherwise reliable and tough F-100s would have their own fair share of early teething troubles on both the F-15 and subsequent F-16 aircraft.

The next issue was armament fit and range. The F-111B's AN/AWG-9 radar and Hughes AIM-54 Phoenix long-range (around 100 miles) were carried over to the F-14 and it was felt that some longer-range missiles other than the AIM-7F Sparrow (around 40 miles max range) was required in the over-water interceptor role, where fleet defence had to keep the enemy – often seen to be long-range Soviet bombers with their own long-range anti-ship missiles – at maximum distance from the carrier battle group.

"While early export Eagles were similar to those used by the USAF, by the 1990s, the machines being sold by McDD/Boeing were more tailored to the customer."

Many in the US Navy felt that the Phoenix was a must for their next generation interceptor so a further F-15N, called the F-15N-PHX was discussed where the semi-recessed AIM-7 Sparrow stations on the shoulders of the intake trunk would be configured to carry four of these huge missiles (the F-14 could carry six as a maximum load) along with either an adapted AN-APG-63 radar to launch the AIM-54 or the AWG-9. A perfect fit? Well, maybe not. Versions of the Phoenix-equipped F-15N Sea Eagle would have weighed around 9000lb (4090 kilos) heavier than an F-15A.

While the sheet specifications would perhaps show that the F-15N would have been more agile than the F-14 Tomcat, the creeping weight increase would have meant that the Sea Eagle would have lost its edge over the land-based equivalent.

One big positive: cost.

ABOVE: ***The Republic of Singapore Air Force bases its training resources at Mountain Home AFB in Idaho. This example is armed with AIM-9X, AIM-120C, SNIPER pod and GBU-10s was seen there in 2014.***

Israel's F-15I Ra'ams are equipped with many indigenous systems.

ABOVE: The Ra'am was first ordered by the IAF after Desert Storm following the F-15E's excellent performance.

F-15 FACTS

An F-15C for the RAF could have been the weapon of choice from the early 1980s and would still have been in service.

Compared to the $38 million the F-14A Tomcat would eventually cost, the F-15 cost just $28 million per aircraft. This cost comparison though was for the F-15A – so it's best to add a fair few million per F-15N for development costs…

Despite the Sea Eagle proposal – as well as possible advanced F-4 Phantom derivatives – the F-14 programme had its own big backers at the Pentagon and in the Navy and it made it through into production. Why? Well, many were still shivering at the big problems thrown up by the forced commonality of the F-111 USAF/Navy, so it's little wonder that there wasn't any metal cut for the Sea Eagle, let alone a fly-off as proposed by some politicians.

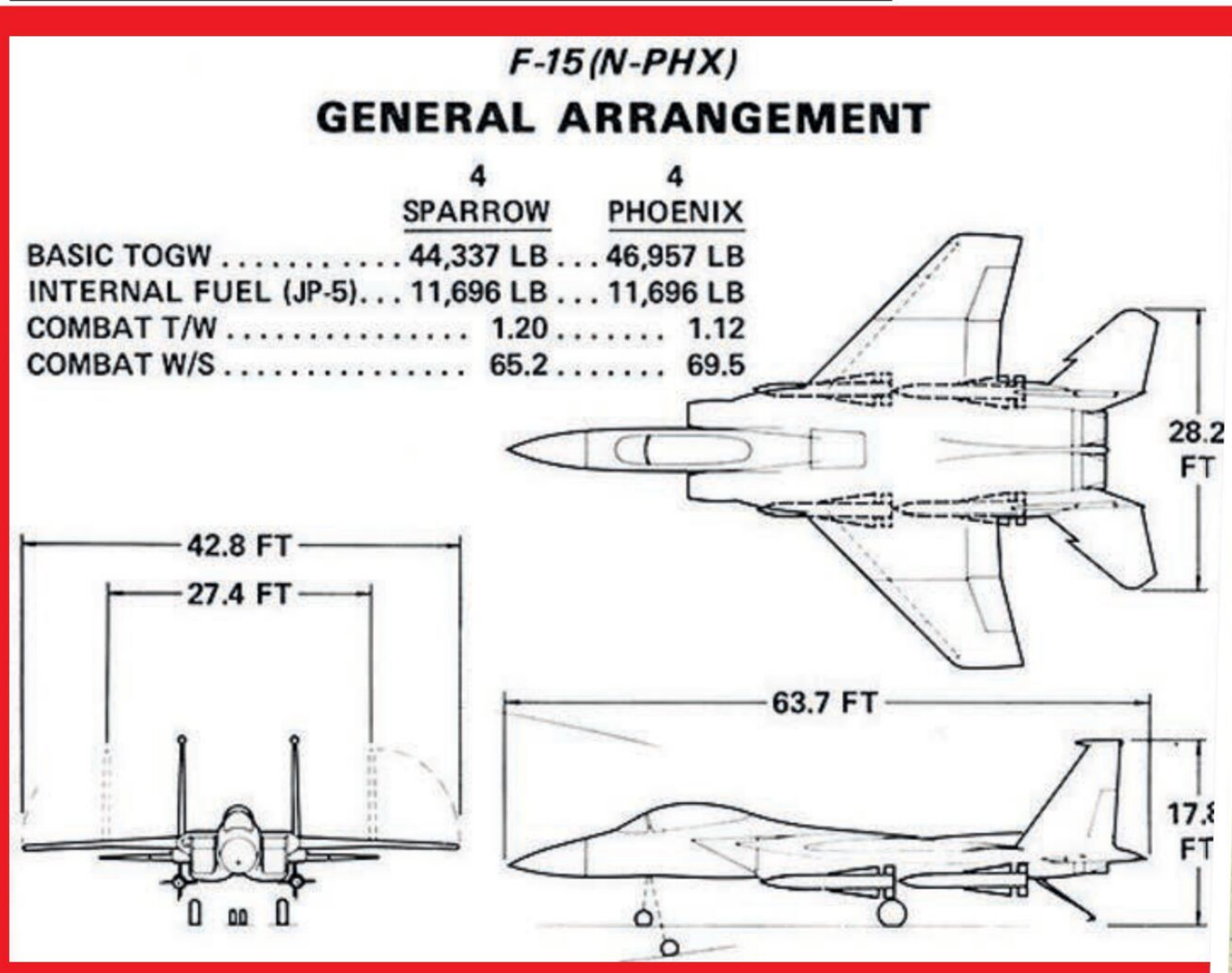
There was even talk of an F-14 Tomcat being configured for the USAF as a Convair F-106 Delta Dart replacement – the interceptor then protecting the continental United States, but politics and inter-service rivalry and mistrust killed that 'Cat' and F-15s and F-16s would instead do the job and supplement F-4s in the role.

So, by 1973 – and with both aircraft in the air and into their respective trials – the Navy stuck with the Tomcat and the Air Force with the Eagle. Probably common sense was served as the Eagle was a true air-superiority fighter/interceptor while the F-14 was the reverse. Still, how would the Miramar Naval Fighter Weapons School ramp known as 'TOPGUN' have looked filled with Eagles? And just think of the 1986 film of the same name. It wouldn't have been the same using single-seat F-15Ns.

One thing that did come out of the various senate hearings was the formation of the Navy Fighter Study Group 4. As the years progressed this would lead to the adoption of a navalised version of the Northrop F-17 Cobra, which would become the McDonnell-Douglas F/A-18 Hornet. So MDD would win out in the end with a navalised land-based fighter, but that was some years into the future.

McDonnell Douglas F-15C/D (UK): Yes, the mighty F-15 was once discussed as a possible Royal Air Force fighter. Flight International of September 9, 1978, published rumours that the F-15 was being considered as a 'stopgap' fighter pending the introduction of the just-flown Panavia Tornado ADV/F.2.

With the ADV/F.2 not considered to be 'in service' until the mid-1980s, there were several schools of thought as to how an F-15 purchase would work. Either a small number of F-15C/Ds then just about to come into service with the USAF would be bought as a 'top-up' to the F-4 Phantom and BAC Lightning force then guarding the UK Air



FLIGHT International, 9 September 1978

935

F-15s for the Royal Air Force?

DEFENCE

ACCORDING to a report in *Interavia AirLetter* the Royal Air Force is considering buying F-15 Eagle interceptors to plug the gap in UK air defences which will exist until the Tornado F.2 (ADV) enters service in the mid-1980s. Three possible purchases are postulated: a small buy of 24 F-15C/Ds to "top up" RAF fighter strength; replacement of the present Phantom/Lightning force by 60-80 Eagles; or a decision to cancel Tornado F.2 and buy more than 150 F-15s fitted with the Marconi Avionics fire-control radar and British Aerospace Sky Flash radar-guided air-to-air missile armament planned for intercepter versions of the Panavia fighter.

In a world where a single stroke of the presidential pen can effectively cancel a project like the B-1, anything is possible, but on the surface an F-15 deal has little to recommend it. Officially, the idea is a non-starter. *Flight* reported last week that the service had considered leasing F-15s, but that according to the Ministry of Defence RAF future plans were unlikely to include the F-14 or F-15.

Reactions on the other side of the Atlantic are equally cool. McDonnell Douglas claims to have heard nothing: "We have not been approached by the British." This line is echoed by the US Department of Defence.

Flight understands that RAF planners have investigated purchasing US-surplus F-4 Phantoms as an interim boost to front-line fighter strength, and that discussions on the F-15 have been at only a low level. The RAF see the F-15 as being less suitable than the two-seat Tornado F.2: Britain requires a long-range intercepter to counter Backfire / Fencer-class low-level intruders rather than a high-performance air-superiority fighter. The Hughes APG-63 radar is also considered to be more vulnerable to electronic countermeasures than its UK counterpart (see *Flight* for August 26, page 604).

One RAF officer close to the Tornado programme tells *Flight* that the Marconi-Elliott radar—popularly, but not officially, known as Foxhunter—was designed from the outset to be highly resistant to hostile jamming or deception. Radar technology has, in his opinion, reached the point when any sensible value of range which a defence planner cares to specify can be obtained. Resistance to jamming is the most important single attribute which is going to be required of radars in the late 1980s and 1990s.

No real savings would result should the F-15 be chosen to carry Foxhunter rather than Tornado. Fly-away cost of an F-15 equipped with the British radar would not be significantly different from the £9·4 million quoted for Tornado F.2, while cancelling the European fighter could further swell the final bill. *Interavia AirLetter* suggests that as an offset the USAF could buy a wing of interdictor/strike Tornado FG.1s to replace the 72 F-111Es based in the UK.

Production-standard F-15C/Ds could well be available to the RAF earlier than Tornado intercepters. Saudi Arabia, for example, expects to take delivery of its first aircraft in 1981-82. Unless the timescale of Tornado ADV airframe development is slipping badly, it would be no quicker to integrate the British radar into the F-15 than to wait for the European aircraft. If F-15s are bought or leased, valuable commonality between RAF strike aircraft and intercepters would be lost.

Although Foxhunter-equipped F-15s bearing RAF roundels seem unlikely, the combination could prove attractive to Australia and Canada, both of whom are in the market for new fighters. British military aircraft procurement since the 1950s has tended to be one long story of promising projects cancelled for reasons thought good at the time. Only a handful of designs such as the Harrier show what might have been. Given this sort of track record, only a brave man would totally discount the possibility that Eagles might one day sport RAF colours.

USAF axes the remotely-piloted vehicle

HAVING spent $1,800 million since 1949 on remotely piloted vehicles (RPVs), the US Air Force has decided to kill off the concept of the unmanned reconnaissance / electronic warfare drone. At one time the service considered an all-RPV force equipped with strike and fighter drones, but in a complete turnround the existing reconnaissance RPVs and support aircraft will be transferred to the Air Force Reserve next year. The electronic warfare RPVs will be de-commissioned simultaneously.

Based at Davis-Monthan, Arizona, the present force comprises 117 AQM-34 drones, 12 DC-130 Hercules launch and control aircraft and ten CH-3 recovery helicopters. The 57 reconnaissance RPVs to be transferred will be retained for possible use in the event of war and fitted with improved mid-course guidance control and infra-red surveillance equipment.

In the heavy jamming environment of wartime Europe it may prove impossible to control RPVs, the USAF feels, and the survivability of the DC-130 control aircraft, both in the air and on the ground, is questionable. Europe is already short of hardened shelters. A chaff corridor would need multiple drone formations to be effective, and current Air Force equipment is incapable of controlling large numbers of drones simultaneously. A five-year programme to convert nine DC-130s into formation controllers would cost $450 million.

Over the next few years the Air Force will continue to acquire AQM/BGM-34 drones to compensate for attrition, but the total programme cost has been cut from $536·7 million to $100·4 million. Unit cost of the remaining 20 RPVs will therefore increase from $1·99 million to $2·56 million.

General Dynamics technicians attach the first set of wings built by Sabca in Belgium to an F-16 on the Fort Worth production line

ABOVE: The F-15N was a proposed navalised version of the basic F-15 airframe which was never built.
ABOVE, RIGHT: Yes, F-15Cs were mooted for the RAF in the late 1970s. Instead the Panavia F2/3 was ordered.

Defence Region (UKADR) – some sources say just 24 aircraft. The second choice was for a larger number of around 60-80 Eagles to replace the F-4Ms and Lightnings while the ADV Tornado matured or an all-out purchase of more than 150 Eagles instead of the Tornado F.2 and as a replacement for all other air defence types then in service.

Of course things weren't quite as simple as all that. Despite the horrendous error of fielding an F-4 with more powerful British engines (the Rolls-Royce Spey) which resulted in an inferior (in respects of speed thanks to increased drag and overall ceiling) aircraft, this RAF F-15 would also have British equipment to make it more politically acceptable. This was thought to be at the time both the Marconi Avionics AI.24 pulse-doppler radar – later called 'Foxhunter' as well as the BAE Skyflash missile (an updated version of the American Sparrow medium-ranged radar-guided missile) and other various British-build sub-systems.

The irony is that – in the Flight International article – it was thought that the future AI.24 Foxhunter radar would be much more resistant to jamming than the AN/APG-63. And yet of course the Foxhunter radar would have its own issues and wouldn't mature quickly enough to match that of the ADV airframe, leading to radar-less F.2s using concrete ballast for some time.

The other option was merely to 'lease' the American aircraft, not such a mad idea and one which (ironically) Italy did with the Tornado F.3 fighter and F-16 to replace the Lockheed F-104S interceptors while it waited for the Eurofighter Typhoon.

So why didn't the UK F-15 materialise? As usual, it was a mixture of politics, economics and a dash of military reality.

Firstly Great Britain is like one giant aircraft carrier, so the fighter that the RAF sorely needed was a long-range interceptor, one more akin to the F-14 Tomcat with its long-range missile armament. The BAC Lightnings were notoriously short-legged and – even by 1978 – only so many F-4M squadrons were dedicated to air-defence. Economically and politically, it didn't seem worth the money or effort to change the F-15's systems for British ones and – with Saudi interest in the fighter version of the Tornado – the ADV project went ahead.

So the 'fighter shortfall' was never filled – at least not at that time. At the time of the possible F-15 deal it was also suggested that extra F-4 Phantom IIs should be sourced from the USA. Again, this plans wasn't pursued – at least not until 1984. Following the Falklands War of 1982, an RAF presence with a section of F-4Ms was based at Mount Pleasant, leading to a shortfall once more for the RAF in the UK and Europe. With rumours of F-15 Eagles and F-14 Tomcats again doing the rounds, instead 15 F-4J airframes were brought out of mothballs and refurbished and entered service in October 1984. They kept all the US equipment – including the J-79 engines, giving better high-altitude performance. They were retired in 1991, a year prior to that of the RAF's main Spey-powered F-4 fleet.

McDonnell Douglas F-15G Wild Weasel VI: Following on from the F-4G Wild Weasel V, the proposed F-15G would follow the Phantom's role with a two-seater to handle the high-workload of the Wild Weasel's Suppression of Enemy Air Defences (SEAD) role over the battlefield. The F-15G was first discussed as far back as 1985 (curiously along with a USAF

"Many versions of the F-15 were considered, including 'Wild Weasel' and 'photo recce' versions."

A number of modern versions of the basic Strike Eagle platform are now being looked at for various customers – possibly even the USAF. These would use ultra-modern wide-screen cockpit displays, the latest in radar/avionics, a zero-hour airframe and multiple AIM-120/AAM carriage points.

version of the Panavia Tornado) where two-seat F-15s – most probably close to the specification of the then flying Strike Eagle – would see a full sensor suite developed from the APR-47 used successfully in the F-4G as late as Desert Storm in 1991.

Another proposal looked at in the mid-1990s was to use F-15C single-seaters in the role (perhaps similarly as RAF Tornado F.3s were used with BAE ALARM anti-radiation missiles). Both types would have employed the latest anti-radar missiles then in the USAF armoury, both Standard Anti-Radiation Missiles, (ARMs), Shrike or AGM-88 High-speed Anti-Radiation Missiles (HARMs) as well as standard munitions to help take out the surface-to-air missiles (SAMs) themselves. In the end the General Dynamics/Lockheed Martin F-16CJ Block 50/52s – with its 'weasel in a can' system: this is the ASQ-213 HARM Targeting System or HTS. Basically this was the F-4G's system, updated, miniaturised and put into a pod.

McDonnell Douglas RF-15 'Sneak/ Peek Eagle': This was the very unofficial name for a replacement for the USAF's fleet of McDonnell Douglas RF-4Cs (and perhaps foreign-service RF-4Es) that were still in service in large numbers in the mid-1970s. Like its predecessor, the RF-15 would have featured a new nose, probably with a somewhat simpler radar, but equipped with optical cameras, SLAR (Side-Looking Airborne Radar) and other updated equipment. No aircraft were built, despite a 1988 USAF requirement to replace RF-4Cs and the RF-16 being also mooted. Today it seems that tactical reconnaissance is the realm of the UAV/RPV fleet.

McDonnell Douglas/Boeing F-15 MANX: Another stillborn project, this was the name for a tailless variant of the F-15 ACTIVE, but no aircraft was such modified.

Boeing F-15F Strike Eagle: Originally a proposed single-seater for Saudi Arabia, the F-15F would use the twin-place airframe, including the E's engines, radar and cockpit multi-function displays. The Saudis originally ordered 24 of this type (ironically, along with 48 two-seaters that were combat capable). Eventually the Saudis settled on their own version of the F-15E, the F-15S.

Boeing F-15H Strike Eagle: This was a proposed export version of F-15E Strike Eagle for Greece (H for Hellas/Hellenic) to replace both the F-4E Phantom II and A-7 Corsair in the attack role. Instead the Hellenic Air Force opted for the F-16C/D Block 52+ and the Dassault Mirage 2000-5 multi-role fighters. Moving forward, the F-15H is not planned to move forward, despite the air force looking towards 4.5 or fifth-generation aircraft to replace older types.

Boeing F-15 Advanced Eagle: Essentially the basis for the 'Advanced' models sold to Saudi Arabia and Qatar, the Advanced Eagle utilises the option of the General Electric GE F-110 engine, two additional hard-points under the wings, full digital fly-by-wire controls, the latest BAE EW equipment, AN/APG-63(V)1-3 or APG-82, NVG and helmet-mounted sight capability, up to 16 (or more) AAMs in the fighter role or the very latest in air-to-ground and 'stand-off' ordinance.

Boeing F-15 Silent Eagle: As documented in detail in the last chapter, this was a 2009 proposal which would marry some 5th generation fighter elements into the proven 4th generation F-15E airframe. Twin-canted tails and RAM (Radar Absorbent Material) would reduce the radar cross section (RCS) of the F-15, as would the use of conformal weapons bays (CWB). The first demonstrator flew in July 2010 but without the altered tail configuration, testing instead a left-side CWB from which it fired an AIM-120 AMRAAM. A lack of orders sealed the Silent Eagle's fate, but some technology has transferred to the F-15 production line.

Boeing F-15 2040C: Again, covered in the final chapter, this is the proposed upgrade to the F-15C, allowing it to work with the Lockheed-Martin F-22 Raptor in the pure fighter role. Assuredly multirole, however this version has a fighter slant with the inclusion of multi-adaptor points to carry around 16 (or more) air-to-air missiles, CFT (conformal fuel tanks) for longer range, the latest AESA version of the APG-63, and the Talon HATE communications pod for data-transfer with 5th gen fighters like the F-22 and F-35 Lightning II.

Boeing F-15GA Strike Eagle: a proposed 'German Advanced' version of the QA airframe bought by Qatar. This was for the Luftwaffe as a replacement for their Panavia Tornado IDS/ECR airframes due to be retired around 2025/2030.

F-15 FACTS

The latest proposed versions of the F-15 could carry as many as 20 air-to-air missiles!

THE F-15 TODAY

Still in service with six air forces around the globe, the Boeing F-15 Eagle in all its guises is still at the very tip of the defence spear...

INSET: With some airframes around 40 years old, a new breed of pilot, younger than the planes they fly are enjoying the F-15. Here are pilots from the 3rd Wing. Another leap forward made since the F-15's first flight has been the very successful introduction of female front-line combat pilots.

A brand-new Boeing F-15SA warps through 'Star Wars' canyon in summer 2018. Could this be the basis of a new-build F-15X?

F-15 FACTS

Any new F-15X would back-up the 5th-gen Raptor, providing sheer weight of numbers.

CHAPTER 8 – THE EYRIE

ABOVE: ***An F-15C from the 71st Fighter Squadron.***

For McDonnell Douglas/Boeing's F-15 Eagle to be in production some 46 years after the machine's first flight is an amazing testament to the strength of the original design.

Since that first flight in 1972, around 1700+ Eagles have soared skywards, carving out an unrivalled record in air-to-air engagements, as well as becoming arguably the most advanced ground-attack/interdictor of its generation.

As I write this – and as the aircraft heads towards its half century – the production line for this amazing airframe is still open and should be until at least 2022. More importantly, with many of the world's leading air forces having just ordered F-15 Strike Eagle derivatives and with others extending the lives of the 'Mud Hens' or dedicated fighter versions that they already have, it seems that the useful life of the original Eagle airframe is secure for at least the next several decades.

Looking back at the F-15's five decades in service, it's the ultimate irony that a machine designed and built as a dedicated fighter and air-superiority platform should now see continued sales success with the multirole strike versions.

But, even with the introduction over the last two decades of genuine 5th generation fighters and combat aircraft (Lockheed's F-22, F-35 and examples from both Russia and China imminent) many air forces will be priced out of the 5th generation game and will look instead to proven designs perhaps packaged with improved technology: aircraft such as the Dassault Rafale, Eurofighter Typhoon and Saab Gripen as well as the Lockheed F-16V, advanced Boeing Super Hornet derivatives and – possibly – updated F-15 Eagle airframes.

Only around 190 of the enormously capable 'Advanced Tactical Fighter' F-22 Raptor made it into service with the USAF – none were built for export with the US government slapping a ban on any such sales. This was despite interest from a number of nations, most notably Japan and Australia. That total production figure is in stark contrast to the original procurement total in the late 1980s of 750 airframes.

With the USAF effectively having a small fleet of 'silver bullet' F-22 Raptors, thoughts soon turned to how the aging F-15 force – or an alternative aircraft – could complement the latest machine. This would mean that the fighter version Eagles would not only be overhauled for more life and flight hours, but Boeing also wanted to look at how to improve the

> ***"With the Raptors being the 'silver bullet', could a new force of F-15s give much-needed back-up to the 5th gen fighters?"***

capabilities of the F-15C/Ds still in service and even make them 'talk' to the newer Raptors, to allow greater inter-operability.

When it came to airframes many F-15s had – by the early part of the new millennium – led hard lives. The USAF had enjoyed an excellent safety record with the F-15. The first Eagle crash took place in 1975 and up to late 2014 just over 120 machines had been lost. While many incidents in the early decades of use were the usual expected (but still unfortunate) ones of operational life such as mechanical issues, pilot error and air-to-air collisions during training, by the 2000s other issues were – naturally – surfacing with aircraft that were getting older and older.

On April 30, 2002, an F-15C from the 46th Test Wing out of Eglin AFB, Florida crashed, killing the pilot Major Japes Duricy. The Accident Investigation Board found that the crash was caused by the structural failure of the left-hand vertical fin during a high-speed manoeuvre. More was to come at the end of 2007. On November 2, an F-15C of the Missouri Air National Guard crashed during ACM (air combat manoeuvring) training following a severe structural failure at 7.8G which saw the pilot – Major Stephen Stilwell – thrown around in the violently shaking F-15C at 18,000ft. Stilwell was forced to eject and suffered a dislocated left shoulder and a shattered left

F-15 FACTS

The F-15 'Albino' fighter community is now largely comprised of Air National Guard units.

BELOW: ***The Air National Guard is now home to the majority of the 'Albino' fighter Eagles. This shark-mouthed F-15C is from the 173rd Fighter wing, 114th Fighter Squadron of the Oregon ANG, as it was seen in 2015.***

Lakenheath's Strike Eagles often take part in exercises around the globe.

"With F-15C airframes coming towards the end of their lives, it makes sense to upgrade and enhance the low-houred Eagles."

arm/elbow as a result of his escape from the aircraft at around 480 knots with parts of it hitting him during the ejection sequence.

Within 10 days around 1100 F-15s across the globe – both fighter and bomber versions – were grounded pending examinations. This severely hampered any Air Defence Operations over the US mainland. By November 15 the F-15E models were cleared to fly and by early January 2008 around 60% of the existing F-15A, B, C and D fleet were allowed to fly once more.

The issue was with a defect in a metal beam – called a 'longeron' – in the 1980-built F-15C that cracked and failed after 27 years and 5700 hours of hard use, causing it to break up during the high-G manoeuvres. This effectively severed the F-15C in two, from the rear, right-hand side of the cockpit. Stilwell's horrified wingman's cockpit voice recorder caught him saying: "Knock it off! Knock it off! Mick 2's airplane just broke in half! Eject! Eject! Eject! Mick 2: Eject! Eject!" Stilwell himself knew he had a serious problem on his hands: "Something very violent was happening to the airplane and it was something I had to get out of. That was a no-doubter: you just gotta get out of it!" With his career as both a 'weekend warrior' ANG pilot and his day job as a Southwest Airlines pilot ruined, Stilwell actually sued Boeing in 2008 although the legal results of the case are shrouded in mystery.

The grounding found that as many as 163 F-15s had some issues with the longeron's design and a small handful – reportedly just nine airframes – had some form of small crack in the component. Repairs were – at the time – estimated to be at around half a million dollars per aircraft affected. This reignited the debate on what to do with the F-15's replacement – the F-22.

Some would argue that the F-15 was past its sell-by date and that the only real answer was to procure more F-22s – at more than $150 million per aircraft – or much more than three times that of an F-15. Despite many recent rumours that Raptor production could be restarted, at time of writing the last F-22 was delivered to the USAF in 2012 and that – as they say – will be that.

Meanwhile, Boeing has been on record to state that F-15C/D fighters could extend beyond their 15,000 hour service life with replaced spars/longerons at $1 million per aircraft and there's also talk of a possible re-winging plan for the aircraft. There have been other plans to extend the life of the old warbird too…

THE 'SILENT EAGLE'

Plans to produce a newer/updated version of the F-15 fighter airframe adopting some 5th generation capabilities have been discussed and perhaps the most interesting one was the 'Silent Eagle'.

In early 2009, Boeing put on display its F-15SE demonstrator which amalgamated certain elements of a 5th generation fighter into the proved (and yet updated) Eagle airframe. This was to be a multirole Eagle, but one with all the abilities of the fighter versions then in service but with some big improvements.

Reducing the 'radar cross section' (RCS) of the Eagle was the number one factor in the Silent Eagle's tweaked design. To this end, Boeing found that canting out those huge twin vertical tails by 15-degrees helped reduce the F-15's RCS. Other technology, such as the use of radar-absorbing materials (RAM) as used in 5th generation fighters and four conformal weapons bays (CWB) which would be in the same location as the former 'FAST' (Fuel And Sensor Tactical) conformal fuel tanks (CFT) would reduce the big fighter's radar signature still further. For 'non stealthy' missions, weapons could still be hung from the various wing and fuselage hard-points. Under the skin other advances included a full fly-by-wire system, the Raytheon APG-82 AESA (Active Electronically Scanned Array) radar as well as an up-to-the-minute electronic warfare suite packaged in the main airframe. The aircraft would also field advanced targeting pods, including an infra-red search and track system. Overall, it was considered that such new-build Silent Eagles – possibly taking advantage of the latest variants of both the Pratt & Whitney F100 and General Electric F110 – would have improved performance, most notably in longer range thanks to the aircraft being lighter and more fuel efficient.

The end result was an F-15 that – compared to the original machine – could (and let's stress the 'could' here) have an RCS one fifth, or less than one fifth of the original F-15 Eagle. This is of course dependent on the aspect of the airframe to the radar that is looking at it: impressive, but not in the same league of a 5th generation fighter with stealth 'built-in' to the aircraft's blueprints. It's also worth noting here that thanks to political pressures, the aim was to be 'stealthy' only against air-to-air threats – not to more advanced ground radars, should these 'Silent Eagles' be sold abroad.

Despite possible customers at home and abroad (Israel, Japan and Saudi Arabia especially could have benefitted from a 'stealthy' Eagle on charge) no orders were forthcoming. This was despite the fact that the conformal weapons bay was tested with a live firing from an F-15E demonstrator in 2010 which also trialled various RAM coatings and paint finishes. The flyaway cost of the SE was thought to have approached $100 million dollars per aircraft, including spares and support which compares to $150 million for an F-22. Some aspect of the Silent Eagle programme found their way into export F-15E variants, notably some of the RCS reduction material and some of the electronic warfare equipment which found its way onto South Korea's F-15 Strike Eagle fleet. South Korea was also partnered with Boeing on the manufacture of the CWBs should the Silent Eagle find orders.

Other exciting tech developed on the Silent Eagle was a next-generation helmet display/targeting system. The Joint Helmet Mounted Cueing System was integrated on the Silent Eagle trials aircraft (an F-15E devoid of the canted-out twin-tails). This allowed the F-15SE's weapons to be aimed where the pilot was looking. A refinement of what had been developed previously by Vision Systems International, this latest version was ergonomically superior, lighter and more reliable than previous systems.

Eventually, despite initial interest from Israel, Saudi Arabia, Japan and South Korea no firm order materialised – although the

F-15 FACTS

New weapons, and targeting systems will keep the F-15 at the tip of the spear.

The Joint Helmet Mounted Cueing System (JHMCS) is used in the F-15, F-16 and F/A-18 Hornet.

"Could advanced F-15 variants hold the key to cost-efficient air-superiority in the years to come?"

ABOVE: ***The Silent Eagle featured weapons bays to reduce radar cross section.***

BELOW: ***The F-15SE could carry a wide array of stores and had canted out tails to aid stealth.***

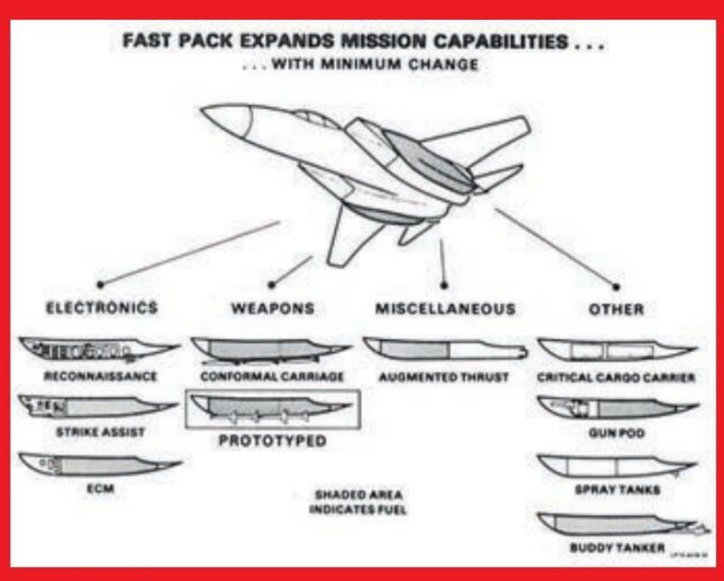
F-15SE was initially the winner of South Korea's 2013 F-X III fighter competition, but this was overturned and now the Republic has placed orders for around 60 Lockheed F-35 Lightning IIs. Sadly, those big canted tails were only seen in Boeing concept art and wind tunnel models.

THE 'GOLDEN EAGLE'

Another 'advanced' upgrade of the current F-15 fleet is called F-15 2040C – otherwise known as the 'Golden Eagle'. This would see the Eagle in service as a viable fighter until 2040 and possibly beyond.

Launched by Boeing in September 2015, the thinking behind this 'Advanced Eagle' is that it would act as a 'force-multiplier' alongside stealth fighters such as the F-22 and F-35. In a way similar to the old 'hi-lo' mix of the 1970s and 1980s – where USAF planners would envisage the smaller, more nimble F-16 Fighting Falcon backing up the supreme F-15 Eagle. In this modern take, the upgraded F-15 2040C fighter would effectively become a 'missile truck' hauling large numbers of missiles into battle with the stealth fighters up ahead.

In both the F-22 Raptor and the F-35 Lightning, stealth is all-important: you don't want to hang anything on the wings if you're taking on a hi-tech adversary. These aircraft have to use their internal weapons bays, meaning that the F-22 carries only



ABOVE: Conformal Fuel Tanks could be used on any new-build fighter F-15… back in the day they were 'FAST' packs and could have also carried sensors or more weapons.

action where Raptors would be taking on large numbers of fourth-generation (or better) fighter aircraft. Utilising the Talon HATE pod, updated Golden Eagles would work in concert with the Raptors to identify and take down a larger fleet of less stealthy foes. To kill such large numbers of enemy adversaries, the F-15 would carry 'quad pack hard-points' where the total number of AMRAAM missiles carried would be increased to a total of 16.

The ideal scenario then would be the Raptors using their advanced sensors and stealth to identify and prioritise the targets ahead and then pass this information to the F-15 2040Cs, with the information displayed on a new 'LAD' (Large Area Display) colour touchscreen in the cockpit. With increased range thanks to conformal fuel tanks (CFTs), they would then move forward and launch a phalanx of fire-and-forget AMRAAMs at their selected targets while the stealthy Raptors and perhaps F-35 Lightning IIs would then use their stealth and sensors to mop up whatever enemy aircraft were left.

This would be a great leap forward as previously Raptors could only 'talk' to other F-22s. The system has even been tested during the USAF's realistic training sorties. In one such exercise, four F-22s working in concert with four Talon HATE-equipped F-15Cs achieved a 41:1 kill ratio against simulated 'Red Air' forces: impressive results. Looking further forward, the use of an ultra-long range missile by the Golden Eagle would strengthen this tactic considerably. However, that is some time in the future as it's argued the US is behind Europe, Russia and the Chinese in the development of long-range missiles since the withdrawal of the F-14 Tomcat and AIM-54 Phoenix combination back in 2006.

EXTRA FUEL

One other large part of the upgrade already mentioned would be the use of the CFTs – or conformal fuel tanks. Way back at the start of the F-15's in-service story, the use of these – then known as 'FAST' packs (Fuel And Sensor Tactical) would effectively increase the range of the fighter variant of the F-15, while not taking up valuable weaponry hard-points and carry extra sensors. In the case of the 2040C variant, the Talon HATE pod takes up the centreline station which is more usually home to a fuel tank. Therefore the use of CFTs would help give the Golden Eagle greater range without sacrificing weapons carriage on the F-15's wing stations.

Back in the day a FAST-pack equipped F-15A, with around 13,000lb of fuel and three 610 US gallon tanks could have a ferry range of around 2700 nautical miles. In the late 1970s McDonnell Douglas even claimed that the use of FAST packs improved the Eagle's subsonic aerodynamics. Initially, the FAST packs – first flown on an F-15 back in 1974 – were to house either fuel and/or other mission-specific avionics (including planned optical/infra-red sensors or a data-share system) but then they fell out of fashion.

Why? Well, back in the 1970s through to the 1990s the USAF had plenty of tankers on station over the mainland USA and across the globe so the free-flow of fuel was never an issue. Compare this to today where the USAF's KC-46 Pegasus is a late, but welcome addition to replace elderly KC-135E Stratotankers. Combat? The three external 'drop' tanks that could be fitted on the F-15A through to D could be jettisoned should battle be joined to regain the Eagle's agility – a FAST pack couldn't and no matter what McDonnell Douglas said in any PR literature there was an aerodynamic and weight penalty to be paid for using non-jettisonable FAST packs. It was also rumoured that the FAST packs cost many man hours to attach and detach when it came to routine maintenance, even when it was claimed it would only take a few hours and the removal of a few bolts.

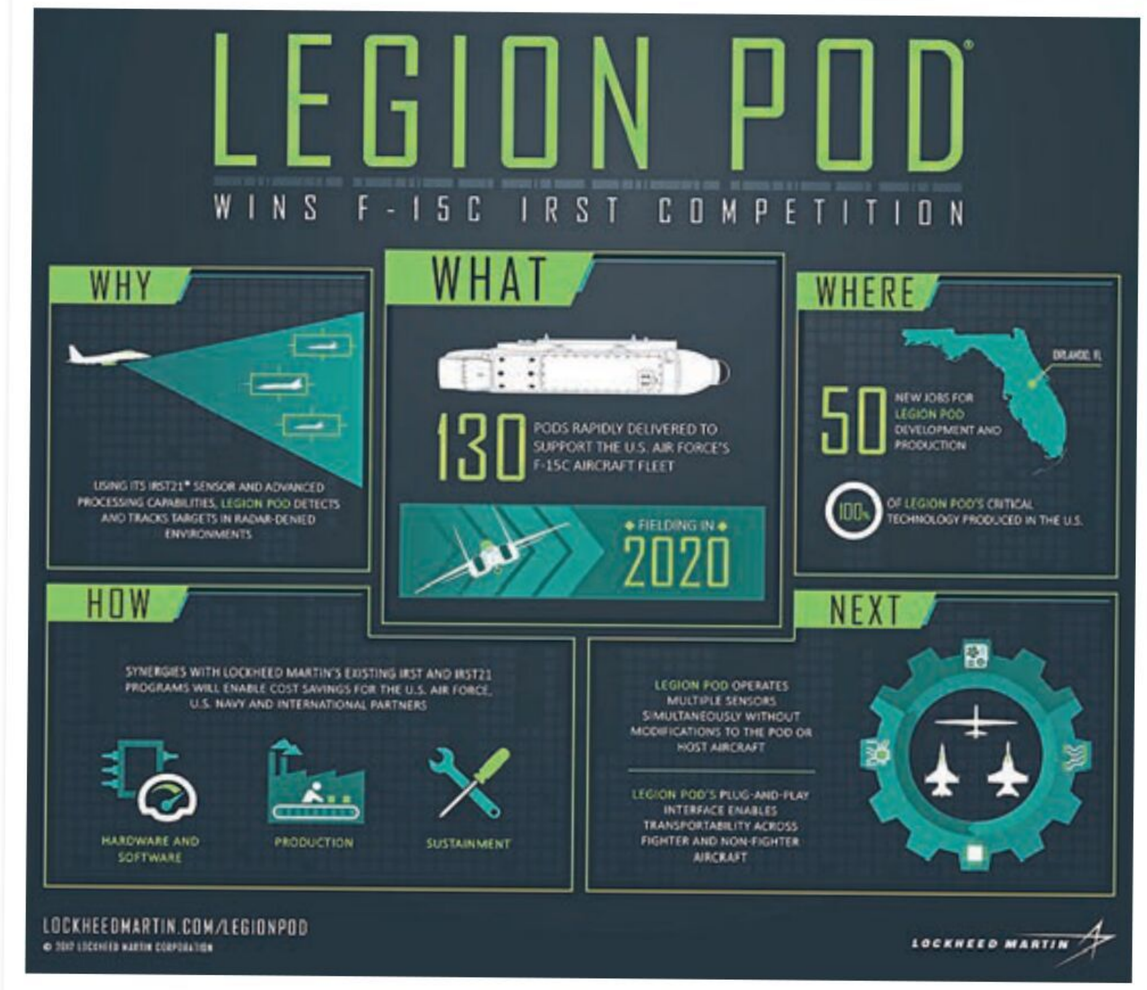
So, on the fighter version of the F-15 airframe, FAST packs fell out of favour. No infra-red targeting systems were developed (or at least fitted) to them, nor was the F-4E's TISEO (Target Identification System Electro-Optical) amalgamated into the pack either, as was originally considered. This was ironic, as – during fights in the 1970s with Aggressor aircraft – what became known as 'Eagle Eye' was being

Boeing's artwork for the F-15 2040C.

used. This was a simple X6 magnification rifle scope, used by the Eagle pilots to get a visual identification on the smaller 'Red Air' aggressor F-5E Tigers. This was because it was hard for the likes of the F-14 or F-15 to 'see' an aggressor F-5 or A-4 Skyhawk until it was about 1.8 to 1.5 miles away, while the much larger Tomcat and Eagle could be seen up to 10 miles away. 'Eagle Eye III' was going to help this situation and be (like the F-4E's TISEO) a wing-root mounted sight – or perhaps it could have been amalgamated into the FAST pack – but it never happened. Instead the basic shape became simply an 849 US gallon CFT, which is seen predominantly on the Strike Eagle and its associated variants.

It has to be said that a few US F-15 fighter versions did see some use with the FAST/CFT packs back in the 1970s and 1980s – but only those based in the extreme north of the country, with the squadrons charged with defending the vast expanses of Alaska. There, the FAST/CFT packs were a useful addition. Israel also utilised the F-15 fighter version (even if used in the strike role) with CFTs.

Today a number of USAF and Air National Guard squadrons have started to use the CFTs to help boost their range, with the 159th Fighter Wing the 'Bayou Militia' taking part in a programme to monitor their effectiveness during day-to-day use.


LEGION POD®
WINS F-15C IRST COMPETITION
WHY
USING ITS IRST21® SENSOR AND ADVANCED PROCESSING CAPABILITIES, LEGION POD DETECTS AND TRACKS TARGETS IN RADAR-DENIED ENVIRONMENTS
WHAT
130 PODS RAPIDLY DELIVERED TO SUPPORT THE U.S. AIR FORCE'S F-15C AIRCRAFT FLEET
FIELDING IN 2020
WHERE
ORLANDO, FL
50 NEW JOBS FOR LEGION POD DEVELOPMENT AND PRODUCTION
100% OF LEGION POD'S CRITICAL TECHNOLOGY PRODUCED IN THE U.S.
HOW
SYNERGIES WITH LOCKHEED MARTIN'S EXISTING IRST AND IRST21 PROGRAMS WILL ENABLE COST SAVINGS FOR THE U.S. AIR FORCE, U.S. NAVY AND INTERNATIONAL PARTNERS
HARDWARE AND SOFTWARE
PRODUCTION
SUSTAINMENT
NEXT
LEGION POD OPERATES MULTIPLE SENSORS SIMULTANEOUSLY WITHOUT MODIFICATIONS TO THE POD OR HOST AIRCRAFT
LEGION POD'S PLUG-AND-PLAY INTERFACE ENABLES TRANSPORTABILITY ACROSS FIGHTER AND NON-FIGHTER AIRCRAFT
LOCKHEEDMARTIN.COM/LEGIONPOD
LOCKHEED MARTIN

***ABOVE:** The Legion pod uses an IRST to engage targets without using radar.*

This programme points to a possible future for the 'Golden Eagle' as a multirole fighter. Remember, late in life the addition of various systems to the Grumman F-14 Tomcat led to a machine which was extremely effective in the air-to-air and (finally) air-to-ground role. With CFTs, the USAF's fighter versions of the F-15 could possibly become more multirole, as any number of various munitions can be carried.

As it stands, it's still up in the air just how far any development of the fighter versions of the F-15 used around the world – but mainly the continental USA – will go. With the re-starting of the F-22 Raptor production line once being considered as well as updated and advanced versions of the Lockheed Martin F-16 being mooted, it's in the balance just what will happen to the three USAF and five ANG operational F-15 fighter squadrons in the immediate future.

It's clear that the Talon HATE/CFT/multiple launcher-equipped F-15 2040C has a clear edge on any F-16 derivative with its own CFTs or otherwise, but is also inferior to the F-22 and F-35 'stealth' aircraft – notwithstanding any arguments about the F-35 versus F-15/F-16 in a dogfight – but with only around 190 fighter-specified F-15 airframes still flying over the US, alongside around 187 F-22

The latest F-15SA on test is carrying 12 air-to-air missiles. With AMBER 'quad packs' this could go to 20 missiles. Any future F-15X would also be fly-by-wire and cost much less than an F-35.

The latest F-15s show the way to any future potential USAF versions: this is a F-15SA from the RSAF's 55 squadron, as seen in 2018 testing outer wing pylons and carrying AIM-9X, AIM-120D, SLAM-ER and JDAMs.

> ***"With fewer Raptors than needed being procured, it could be that some Eagle 'back-up' model would help hold the line for a decade or two."***

Raptors time is ticking on how best to defend the continental United States.

Meanwhile, derivatives of the Strike Eagle continue to rack up the sales successes. Sales to Saudi Arabia, Singapore and Qatar will ensure the production line is open until at least 2022 – and possibly beyond: Boeing has even proposed an F-15GA (Germany Advanced) as an option to replace the retiring Panavia Tornados, although it's considered that additional orders for the Eurofighter Typhoon is a more likely and politically acceptable decision.

The F-15QA (Qatari Advanced) is the most up-to-date Eagle yet flown, boasting an advanced cockpit with Large Area Displays, full fly-by-wire system and a new wing. The wing keeps the Eagle's trademark aerodynamic shape and profile but is internally redesigned making the wing itself stronger than before. It's this new wing that Boeing feels could be the basis of any upgrade to existing fighter and fighter-bomber Eagles in years to come, despite some 'wing repair' kits having been fitted to existing USAF F-15s.

As this book went to press more information was forthcoming that an F-15X – basically a 2040C Eagle, based on the advanced QA/SA versions for Middle Eastern customers - had been quietly offered to the USAF. This was another multirole machine that would plug the gap between 4th and 5th generation fighters and be used in conflicts that wouldn't require stealth. It could be manufactured in two or single-seat versions.

These speculations, as well as solid new sales, newer, more advanced weaponry and the inclusion of the option of General Electric F-110-GE-129 engines for any potential customer shows that the future for this aircraft as it nears its half century is still very rosy indeed.

F-15 FACTS

Modern Eagles have newer radar, wings, weaponry and defence systems than the original machines built in the 1980s.

FOREIGN EAGLE UPGRADES

The Israel Air-Defence Air Force was the first foreign air arm to choose the F-15 and the first to take it into combat.

They've relied on the abilities of the F-15 Eagle since 1976 when the first F-15A and B models were delivered. Although latterly they have bought the multi-role versions of the Boeing fighter, they still have large numbers of the original F-15 fighter variant in service and keeping these machines relevant and up-to-date has been a priority for the force.

Long before the development of the F-15E Strike Eagle, the two-seater F-15B/D Baz in Israeli service has been a capable strike aircraft while the single-seaters have reigned supreme in the fighter role. Even with successive upgrades on individual aircraft it was clear to the IAF by the mid-1990s that a fleet-wide series of updates would be the best option.

'Baz 2000' was the name of the programme which ran from 1995 to 2005 and saw many improvements made to aircraft and 8000 hours were spent on each aircraft bringing them up-to-date. The changes were heavily based on the USAF's Multi-Stage Improvement Program, but crucially it also included some upgrades which had come on-stream with the introduction of the F-15I Ra'am.

Most importantly was the introduction of a common cockpit configuration, new multi-function displays in both cockpits (in the case of the D-models) including updated 'HOTAS' (Hands On Throttle And Stick) controls as well as the upgrade to the radar so the Baz could fire the latest versions of the AIM-120 missile as well as be integrated with the latest Israeli short-range missiles, such as the Python 4, off-boresight dogfight missile and an Elbit helmet mounted sight.

A new electronic warfare system was installed along with more modern computers and the latest GPS navigation systems. Perhaps the biggest job was the complete rewiring of all the Eagles chosen for the upgrade.

Even with the order of F-15Is in the 1990s, as recently as 2016 the IAF has been eagerly adding to its stocks of the original fighter version of the F-15. Nine ex-Air National Guard two-seat F-15Ds were donated by the US government and – despite some being first flown back in the late 1970s – they were also refreshed and reconfigured with Israeli electronics and sub-systems to be brought into line with other Baz jets in the IAF's inventory. These two-seaters are prized assets, handling a number of important missions including reconnaissance and strike missions. These old airframes were subjected to a full 170-day upgrade, in effect making them almost 'as new'.

In Israeli service the modified Baz fleet should be in use for another couple of decades and it also may be updated still further – perhaps along the same lines as the USAF's Golden Eagles, with an AESA radar so it could provide a useful back-up to the F-35I Adirs on order.

In the Far East, Japan's fleet of F-15 Eagles is the largest outside of the USA with 223 built, the majority being assembled under licence by Mitsubishi Heavy Industries. The F-15J and DJ are – similarly to the IAF's Eagle fleet – both ageing (the first Mitsubishi-built Eagle first flew in 1980) and a prized asset.

The JASDF (Japan Air Self-Defence Force) has seen the Eagle subject to a rolling upgrade over the years with various indigenous systems and weapons – including the AAM-3 short-range missile. In the last 15 or so years a number of upgrades have found their way onto the Eagle fleet, including more powerful computers, upgrades to the licence-built F-100 engines, new ejection seats and the Raytheon AN/APG-63 (V)1 radar which will be married to the Japanese-designed AAM-4 – which is broadly equivalent to the AMRAAM. It is also hoped that the replacement for the AAM-3, the AAM-5 – a close-in dogfight short-range missile will be married to a modern helmet sight system.

It's also been rumoured that – akin to the 2040C project – the JASDF would like to see the carrying capacity for their F-15Js updated from eight to 16 missiles. In fact, it could be that the Japanese embark on a major update to the Eagles which could even include re-winging a certain number of the fleet: but when? Gene Cunningham, vice president of global sales at Boeing said: "Japan has more than 200 F-15s in service and they are of great importance to the JASDF. It's important to keep those planes current and upgrade them with a more capable radar, defensive systems and more capable weapons. This is important as the Japanese Defence Forces

LEFT: Israel's Baz and Ra'am fleet has been at the forefront of many upgrades over the years.

adapt to the current pressures in the region, however we don't think we will hear what their final plans are until the end of 2018 or the beginning of 2019."

The pressures in the region include China being somewhat more boisterous than in the past, with both naval and air forces often being engaged by F-15Js and the indigenous Mitsubishi F-2 fighter-bombers. It was no secret that Japan wanted to buy the F-22 Raptor but was frustrated by the US's ban on the export sale of the type. While the sale of F-35s is going ahead, Japan is also looking at the development of its own 5th generation 'stealth' fighter possibly alone (Japan first flew its Mitsubishi X-2 stealth demonstrator in 2016) or in conjunction with Lockheed Martin. This is rumoured to share design cues from both the Raptor and the Lightning II, but with any aircraft being many years away from service entry some form of updated and up-gunned Eagle could well fit the bill as tensions in the East China Sea heighten.

Be it the Middle East or the Far East, it seems that the Eagle will be soaring in the skies for some time to come.

BELOW: Japan's Eagles have also received both new systems and weaponry.

The Raptor has both stealth and agility in its armoury.

LAST OF THE DOGFIGHTERS?

It's the weapon system that people love to hate: Lockheed Martin's once-troubled F-35 Lightning II.

It could be argued that 4th generation fighters like the F-15, F-16 and F-18 will be the last of the great dogfighters if reports on the F-35's performance are anything to go by. The Lightning II has come in for some sharp criticism over recent years. A much-publicised report on www.warisboring.com in 2015 went into graphic detail on how an F-16D laden with two external tanks could best a 'clean' configured F-35A in a dogfight. It went on to state that not only was the F-35 at a distinct energy disadvantage to the tank-toting F-16 but that it also had a comparatively poor rearward vision. A number of engagements were made during the tests at altitudes from 10,000ft to 30,000ft.

That's not all, as recently as March 2018 pilots, were still having to defend the performance of the newer jet as – in simulated battles over Japan – the F-15 Eagle was besting the USAF's latest fighter – now and again – despite some well publicised victories where F-35s recorded a 15:1 kill ratio or better at Red Flag exercises. Some claims put that kill ratio as high as 24:1.

But, while the F-35 is used more

RIGHT: The F-35 Lightning isn't supposed to get into a turning fight.

ABOVE: Israel's Eagles have never been bested in air-to-air combat.

effectively and both the sensor suite and suitable tactics are developed it's obvious that the 'old hands' in the teen series fighters are going to notch up the odd win. They've got the experience, after all.

Retired US Marine Corps Lt. Col. David 'Chip' Berke said: "For the F-35, the best is yet to come. The biggest limitation for the F-35 is that pilots are not familiar with how to fly it. They try to fly the F-35 like their old airplane. New pilots who have never flown a legacy jet before will instead learn how to fly the F-35 like the unique plane it is. They're going to be your best, most effective tacticians."

So, during this interesting cross-over period between 4th and 5th generation fighters it's natural that the newer jet is going to be up against it. USAF F-15 pilot Brock McGehee is based at Kadena Air Force Base in Japan and admits that 'sometimes' the F-35 loses out to the older jet.

With this in mind there have been a few notable critics of the F-35 airframe – most notably Pierre Sprey, one of the lightweight fighter mafia, one of the men behind the F-16 Fighting Falcon. He went on the record during 2012 to call the F-35 a 'turkey'. He adds: "It's an inherently a terrible airplane. It's a dumb idea to go for a multi-mission aircraft. You have something that's supposedly a close-support, a deep interdictor, a bomber and an air-to-air fighter. You've compromised the aircraft right there: then you saddle it with the bureaucracy of three services; the USAF, the US Navy and the US Marines. The thing has no wing so it can't turn, it's got a fat fuselage to house a lifting fan for the vertical landing that the Marines want in the specification. In dogfighting it's hopeless. A 1950s Mirage or MiG-21 could whip the F-35."

Justin Bronk, an expert at the Royal United Services Institute also agrees that the F-35 is perhaps trying to do too much out of a single airframe: unlike the F-15 airframe which was developed as a top-notch dogfighter – despite the size and weight of the fighter versions of the Eagle. He said: "The F-35 as a concept has suffered since its inception from attempting to solve too many problems in a single airframe for too many potential users.

"In order to keep the programme alive and justify the enormous expenditure which has thus far been poured into the project, the aircraft's proponents have oversold the F-35 as the answer to every Western combat air requirement. The F-35 will not be as effective as the A-10 Thunderbolt II at close air support using a heavy calibre cannon danger-close to troops on the ground. Equally, the F-35 cannot match a 4.5th generation fighter such as the Eurofighter Typhoon in raw performance terms, nor out-turn one in a within-visual range dogfight. However, the aircraft was never designed for either of these tasks."

'Chip' Berke agrees: "The thing is, we all want to avoid dogfighting at all costs. The strength of the 5th generation platform is to play to our strengths and in an F-22 and F-35 it's about stealth. We don't want to turn with an adversary."

So is the age of the dogfight dead? The last time a western fighter shot down an enemy in what could loosely be termed as a dogfight was back in 1999 where NATO F-16s shot down Serbian MiG-29s that encroached a 'No-Fly' zone – that's almost two decades ago. Dogfighting was supposed to have ended when jet propulsion ushered in the new era of combat above the skies of Korea. They said the same before Vietnam – missiles would signal an end to dogfighting and now stealth will do the same.

History has since proved otherwise, but like the F-4 Phantom before it, will the F-35 be forced to be a dogfighter and find itself embroiled in a battle it wasn't designed for? If so, perhaps the F-15 will find itself as relevant as ever.

Perhaps the last word should be left to Irving 'Irv' Burrows, the first pilot to take an F-15 Eagle aloft. He said: "A little over two years after first flight and after some 3000 test flights on several test airplanes the first operational F-15 was delivered to the Air Force. Since that time the Eagle has undergone continuous improvement and testing. The most recent models, though they appear much the same as the F-15A we first flew is more than 30 years newer in technology, has vastly increased capability and carries a two-man crew rather than a single pilot.

"The Weapons Systems Operator is in the back seat and current technology allows the airplane to fight in both the air-to-air and air-to-ground battles in all kinds of weather. Until the next generation of fighter-bomber is available, the Eagle remains the Air Force's 'weapon of choice!'"

F-15C INSTRUCTOR HITS 4000 HOURS!

Not many people cross the thresholds of big hours in the fighter community thanks to short missions or hops – but one who did was Colonel Brian Kamp, of the Air National Guard.

Brian 'Spider-man' Kamp spent 28 years flying the McDonnell Douglas and latterly the Boeing F-15 Eagle during a long and illustrious career. It was in September 2017 that 'Spider-man' when through the 4000-hour mark while flying from the Nellis Air Force Base as an ANG advisor to the Air Force Warfare Centre.

Kamp joined the USAF after his own father had served 27 years in the service and his grandfather had fought in the Second World War, including during the D-Day Landings of June 6, 1944.

Kamp said: "The 4000-hour milestone was never a goal I was seeking, my passion for flying but instructing for the last quarter-century made reaching that mark inevitable. I have been fortunate enough to be a pilot and instructor for this long. It's a passion of mine especially when you see the students' progress and improve once they understand a specific topic."

ABOVE: Kamp in the cockpit of his F-15C.

Kamp departs Nellis for the final flight.

Kamp explained that he uses his good and bad experiences as examples in the classroom for students to learn from. And while he's never had to eject in more than 3000 sorties – he's had his fair share of issues, including being shot at in Desert Storm, to a mid-air collision and several in-flight malfunctions!

He says: "After that many sorties, only 1% of them were in-flight emergencies – but that's still more than 30 in-flight emergencies! What we do as fighter pilots is inherently dangerous, and I've lost more than a dozen fellow F-15 brethren over the last 28 years just doing their jobs. This milestone could not have happened without the professionalism and dedication of Eagle-Maintenance in the USAF."

Kamp finally retired from the ANG in March 2018 after more than 30 years in the USAF.

INSET: Colonel Brian 'Spider-Man' Kamp.

HIGH-HOUR WHIZZO!

ABOVE: 'Moses' Meza at the presentation of his 4000-hour patch.

Despite being around a decade or younger than the 'legacy' fighter versions of the F-15, the Strike Eagle community has its own 'high milers'.

One is Weapons System Officer Lt Col Trinidad 'Moses' Meza, the 336th Expeditionary Fighter Squadron deputy operations group commander – seconded there from Nellis Air Force Base where he is an operation test WSO. He passed the 4000 hour mark on a combat mission on March 21, 2018. Moses said: "It's a pretty special feeling and an honour to be able to live out a childhood dream for 18 years! This is my childhood dream come true. I have been able to fly with some pretty amazing people and flying is incredible. "

His commanding officer Lt Col Matthew Swanson explained just how rare a feat such high-hour aircrew are. "It's incredible really," he said. "I've not known anyone who has reached 4000 hours personally before. Things like this are not routine. Some of our aircraft have just 8000 hours on the airframe; some have 10,000. Most people will have around 300 to 400 combat hours on type.

"If you really get a lot, you might tip 800 or 1000 which is still pretty rare. The very high timer flyers may finish their careers between 1500 or 3000 total flying hours. That's on all types so 4000 is off the charts and to he's had to work hard and be good at what he does."

When he broke the magic 4000 hour total, Meza was on his ninth deployment: one which he volunteered for 'somewhere in south-west Asia' according to the USAF press release. In total during his career, he has completed more than 1300 combat flying hours and about 1920 sorties. His other deployments include Incirlik Air Base, Turkey; Al Udeid Air Base, Qatar; Al Dhafra Air Base, United Arab Emirates, Afghanistan; and Ethiopia.

As the F-15E's WSO, Meza handles the air-to-ground targets and threats in the Strike Eagle. He is able to display information from the radar, electronic warfare or infrared sensors; monitor aircraft or weapons status and possible threats; select targets; and use an electronic 'moving map' to navigate. Swanson said: "He is responsible for guiding in the bombs, for talking with the joint teams on the ground and understanding the tactical situation on the ground, so he's busy."

Meza acts as an operation test WSO at his home station, Nellis Air Force Base, Nevada. Meza explained: "We are charged with testing all the new software for the F-15E, any new weapon systems so that when they get released into combat they are ready to go. It's very rewarding and a lot of fun. I was part of the first aircrew that shot an operational AIM-9X off of an F-15E and also flew in the first aircraft with the new radar that is currently being used."

Swanson added: "He has really been an asset when things aren't working right or when it comes to how to best deploy the aircraft with the systems we have. He has been a real value to the team as he knows how the jets are built, what the software is and that sort of thing. He's also a tactical Yoda! He's the guy you go to when you have questions."

Meza's huge amounts of experience means the younger aircrew around him can benefit from that directly. Meza explained: "The reason I continue to mentor younger aviators is to provide advice based on past experiences. One of the things I enjoy most is watching young kids show up with no experience and full of energy – but no idea what to do with that energy – and moulding them into professionals, leaders and well-seasoned, well-trained aviators."

F-15 FACTS

F-15 WSOs spend very little time looking outside the aircraft's cockpit – unlike the pilot

Display F-15 Airframes

UNITED KINGDOM
F-15A
- 74-0131 – Wings of Liberty Memorial Park, RAF Lakenheath.
- 76-0020 – American Air Museum, Duxford.

GERMANY
F-15A
- 74-0085 Spangdahlem, AFB.
- 74-0109 – Auto Technik Museum, Speyer.

NETHERLANDS
F-15A
- 74-0083 (marked as 77-0132) – Nationaal Militair Museum, Kamp Zeist.

ISRAEL
F-15A
- 73-0098 – Israeli Air Museum, Hatzerim.
- 73-0107 – Tel Nof Air Force Base.

SAUDI ARABIA
F-15D
- RSAF Museum, Riyadh.

JAPAN
F-15A
- 74-0088 – Kadena Air Force Base.

UNITED STATES
F-15AS
- 71.281 – 37th Training Wing, Kelly Field, San Antonio, Texas.
- 71-0281 – Tactical Air Command Memorial Park, Hampton, Virginia.
- 71-0283 – Defense Supply Center Richmond, Virginia.
- 71-0285 – Boeing Avionic Antenna Laboratory, St. Charles, Missouri.
- 71-0286 – Octave Chanute Aerospace Museun, Rantoul, Illinois.
- 72-0119 'Streak Eagle' – National Museum of the USAF, Wright-Patterson AFB, Dayton, Ohio.
- 73-0085 – Museum of Aviation, Robins AFB, Warner Robins, Georgia.
- 73-0086 – Louisiana Military Museum, Jackson Barracks, New Orleans, Louisiana.
- 73-0099 (Marked as 77-0099) – Robins AFB, Warner Robins, Georgia.
- 74-0081 – Elmendorf AFB, Alaska.
- 74.95 – Alaska Aviation Heritage Museum, Anchorage, Alaska.
- 74-0095 – Tyndall AFB, Panama City, Florida.[155]74-0114 – Mountain Home AFB, Idaho.
- 74.118 – Langley AFB, Virginia.
- 74-0118 – Pima Air & Space Museum, adjacent to Davis-Monthan AFB, Tucson, Arizona.
- 74.119 – Castle Air Museum, Atwater, California.
- 74-0124 – Air Force Armament Museum, Eglin AFB, Florida.
- 75-0026 – National Warplane Museum, Elmira Corning Regional Airport, New York.
- 75-0045 – USS Alabama Battleship Memorial Park, Mobile, Alabama.
- 76-0008 – March Field Air Museum at March ARB, Riverside, California.
- 76-0009 – Kingsley Field Air National Guard Base, Klamath Falls, Oregon.
- 76-0014 – Evergreen Aviation Museum, McMinnville, Oregon.
- 76-0018 – Hickam Field, Joint Base Pearl Harbor-Hickam, Oahu, Hawaii.
- 76-0024 – Peterson Air and Space Museum, Peterson AFB, Colorado.
- 76-0027 – National Museum of the United States Air Force, Wright-Patterson AFB, Dayton, Ohio.
- 76-0037 – Holloman AFB, New Mexico.
- 76-0040 – Otis ANGB, Cape Cod, Massachusetts.
- 76-0048 – McChord Air Museum, McChord AFB, Washington.
- 76-0063 – Pacific Aviation Museum, Ford Island, Joint Base Pearl Harbor-Hickam, Hawaii.
- 76-0066 – Portland Air National Guard Base, Oregon.
- 76-0076 (Marked as 33rd Fighter Wing F-15C 85-0125) – roadside park, DeBary, Florida.
- 76-0080 – Jacksonville Air National Guard Base, Florida.
- 76-0088 – St. Louis Air National Guard Station, Lambert Field, Missouri.
- 76-0108 – Lackland AFB/ Kelly Field Annex, Texas.
- 76-0110 – Mountain Home AFB, Idaho.
- 77-0068 – Arnold AFB, Manchester, Tennessee.
- 77-0090 – Hill Aerospace Museum, Hill AFB, Utah.
- 77-0102 – Pacific Coast Air Museum, Charles M. Schulz-Sonoma County Airport, Santa Rosa, California.
- 77-0146 – Veterans Park, Callaway, Florida.
- 77-0150 – Yanks Air Museum, Chino, California.

F-15B
- 73-0108 – Luke AFB, Arizona.
- 73-0114 – Air Force Flight Test Center Museum, Edwards AFB, California.
- 75-0084 – Russell Military Museum, Russell, Illinois.
- 77-0161 – Seymour Johnson AFB, Goldsboro, North Carolina.

ON SALE NOW

132 page, full colour, brand new bookazine

CONCORDE

A wonder of innovation and a 20th century icon - Concorde pushed the boundaries of speed, technology and luxury. It made its first flight 50 years ago next year, in 1969.

The magnificent white bird, travelling at twice the speed of sound between London, Paris and New York, represented the pinnacle of commercial air travel.

When it first took to the skies its systems were the most refined and complex ever seen, its pointed nose, slender fuselage and delta wing gave it the appearance of an arrow aimed at the horizon and it went faster than a rifle bullet.

Concorde's passengers were heads of state, royalty, pop stars, millionaires and those so caught up in the dream of supersonic flight that they were willing to part with the enormous cost of a ticket for the greatest airliner ever made.

Concorde: Supersonic Speedbird - The Full Story gives a complete account of this incredible aircraft.

ONLY £6.99

Visit: www.classicmagazines.co.uk/thebookshelf

Call: 01507 529529

Also on sale in major UK newsagents, plus other stores

classic magazines

F-15 EAGLE

The McDonnell Douglas F-15 Eagle is the undisputed king of fighter aircraft, scoring around 105 kills for zero losses in air-to-air combat.

Originally designed as a pure air superiority machine to replace the multi-role F-4 Phantom II, the Eagle has since morphed into one of the most technologically advanced fighter-bombers in its class: the Strike Eagle.

First taking to the air in 1972 and entering service in 1976, around 1600 F-15s have been built for six air forces around the world. Fast and agile but also large and expensive, only the wealthiest nations could afford the F-15 Eagle.

With almost 40 years of combat operations to its credit the Eagle has been at the very sharp end since entering service. The Cold War saw the Eagle as the defensive tip of the spear for the Free World, while the Israelis first blooded the Eagle in the Middle East when they first took delivery in 1979. Since then both fighter and strike versions have been in almost constant action, through Desert Storm, Operation Iraqi Freedom and beyond in the war against terror.

With production likely to continue at least until 2022 – 50 years after its first flight – the story of the F-15 Eagle continues…